ARCHIVES OF OTOLOGY.

OTITIS HÆMORRHAGICA.

By P. McBRIDE, M.D., F.R.C.P.E., F.R.S.E.,

SURGEON TO THE EAR AND THROAT DEPARTMENT, ROYAL INFIRMARY; LECTURER ON DISEASES OF THE EAR AND THROAT, SURGEON'S HALL, EDINB.; AND SURGEON TO THE EDINBURGH EAR AND THROAT DISPENSARY.

IT is now some years since Roosa first called attention to a peculiar form of acute inflammation of the middle ear, which he designated otitis media hæmorrhagica. Since then the affection has been more or less generally recognized, and a considerable number of instances have been recorded (compare "Diseases of the Ear," by St. John Roosa, 6th edition). Such being the case, I had no intention of adding to the literature of the subject, although three very distinct examples have come under my notice, and this must be my excuse for the very imperfect records of my own cases—which are, indeed, principally from memory. My reason for now putting pen to paper is that I believe myself to be, through accident, enabled to explain what, to my mind, at all events, seemed to be a pathological anomaly. Hemorrhagic otitis media, as described by Roosa and observed by myself, usually runs a very acute course. Thus my first case was somewhat as follows:

A young married gentleman was travelling by train and suddenly felt most excruciating pain in his ear. In a very short time he felt something give way, and quite a free hemorrhage occurred. On getting home he sent for me, because he was alarmed by the bleeding. In this case, inflammation of the meatus and suppuration of the middle ear afterwards set in.

My second case (of which I retained short notes) curiously enough also affected a gentleman after travelling

by railway. Mr. P. had severe pain in the right ear on Friday evening. During the night it bled, and the pain was relieved. The condition on Monday afterwards was as follows: H. D.: watch normally heard at thirty inches, only perceived on contact; tuning-fork best heard in bad ear; right membrane shows signs of past inflammation and covered in part with clotted blood; pharynx congested. In this instance the hearing was much improved by treatment directed to the pharynx, together with the use of Politzer's bag.

My third case was hardly so typical as the others, for in it blood only escaped after incision of the membrane, a proceeding which was rendered necessary by great pain and evident bulging. The color of the drum-head in this instance was bright-red, as is usual in acute otitis media; but after paracentesis and the evacuation of the tympanic cavity the color was more bluish-gray.

The leading characteristics, then, of otitis media hæmorrhagica seem to be (1) great violence of its symptoms; (2) rapid course; (3) the escape of blood instead of pus.

One is naturally inclined to ask, whether we have any analogous form of inflammation in other organs, and, so far as I know, the answer must be in the negative. It is true that hemorrhagic retinitis presents some resemblance, and, indeed, Roosa has found the two conditions associated; but it is well to remember that retinitis hæmorrhagica is commonly met with in gouty persons, whose vessels are presumably diseased, while otitis hæmorrhagica, although its occurrence, as we shall see, is favored by weakness of the arterial coats, is quite frequently found in persons in the prime of life and strength. There has of late been described a hemorrhagic form of laryngitis, but it is not analogous to the condition in question, because, in the first place, the signs and symptoms of acute inflammation are but slight; and, in the second place, it is quite likely that the hemorrhage may be due to the associated cough. (Compare "Krankheiten des Kehlkopfes," by Gottstein, p. 64.)

Having then pointed out that there is met with in the tympanum a form of inflammation which in its combined

clinical and pathological characters differs from the various recognized types, we must next consider its etiology or, better, pathogenesis. Roosa explains its occurrence in the following sentence: "They are, I think, to be considered as cases of acute inflammation of the lining membrane of the middle ear, in which the morbid process has an unusually rapid and violent course, so that not merely an exudation through the walls of the vessels, but an actual breaking down of the walls themselves occurs." So far as this explanation goes it is probably correct, but it leaves unexplained why such a form of inflammation should occur in the ear, and there alone, for otitis hæmorrhagica cannot be compared with the hemorrhagic inflammations and exudations which occur in morbid conditions of the blood. We must, I believe, look for further elucidation to the physical conditions of the tympanic cavity. It will be remembered that the early changes of inflammation are characterized by dilatation of the arteries, which goes "on increasing for ten or twelve hours [Payne: "Quain's Dictionary of Medicine"] till these have double their original diameter and pulsation becomes very prominent in them." If we take this into account, and if we further assume that the inflammation occurs on a surface which is under less pressure than any other part of the body, it requires no great stretch of imagination to suppose that, instead of running its usual course, it should be suddenly aborted by the rupture of the distended arterioles. Now this combination of physical conditions is quite likely to happen in the tympanum, but is not easily imaginable in any other part. Every aurist is familiar with cases of advanced middle-ear catarrh in which there is marked obstruction of the Eustachian tube, but in which the drum-head, owing to thickening and want of elasticity, is by no means drawn inwards to a corresponding extent. When such a state of matters is present, the intratympanic structures are always under less pressure than other parts, and so in a condition favorable to the development of inflammatory hemorrhage. Again, acute inflammation may manifest itself in the Eustachian tube some time before the tympanum is affected; if then the former

be quite closed, a condition of the latter similar to that described in the preceding sentence occurs.

So far I have stated my belief that the inflammatory form of otitis media is usually due to preceding acute or chronic obstruction of the Eustachian tube, especially if associated with a thickened drum-membrane; it may of course also occur as a result of diseased vessels. That diminished pressure increases the tendency to hemorrhage must be self-evident to all, and as an example I need only mention the frequent occurrence of retinal hemorrhage after the operative relief of tension. The following are brief notes of a case which recently came under my care, and which seems to me to explain and illustrate the pathogenesis of hemorrhagic otitis media.

Mr. —— consulted me on the 16th of February. Three weeks ago he went into a caisson; he has had an excessive discharge from the nose for six months since his return from America. In the caisson he felt his ear very painful, and having misunderstood the directions given him he swallowed, instead of performing Valsalva's experiment. During that night, and since, he has had a feeling of distention in the head, which disappears when pressure is made on the parietal or auriculo-temporal region. No giddiness or tinnitus. Tuning-fork is heard louder in the right (affected) ear. Had the ear syringed by a doctor, but it did no good.

H D: watch, L, $\frac{7}{30}$; R, $\frac{1}{30}$.

Left membrane slightly indrawn, but otherwise normal.

Right membrane is much indrawn above, and its lower part is of a dark purplish-blue color, while above and in front there are pale brown patches (serous exudation). Inflation by Politzer's method causes the membrane to move outwards, and leaves only a bluish patch in the centre; H D is also increased to $\frac{3}{30}$.

The throat is catarrhal, but unfortunately posterior rhinoscopy was not practicable.

Treatment.—Syringing the nostrils gently with a solution of borax and soda and the air-bag.

Feb. 16th.—H D: $\frac{\text{gentle contact}}{20}$, membrane much depressed, incus prominent, color still purple; after inflation, H D: $\frac{3\frac{1}{2}}{30}$, membrane well forced out, *lower part* shows dark color, probably due to free clot.

17*th.*—Membrane again indrawn, and showing dark coloration in lower part, surrounded by a rim of gray color. H D: $\frac{1}{30}$; after Politzerizing, $\frac{2\frac{1}{2}}{30}$.

18*th.*—Dark color less, and disappears on inflation, but there then appear (1) bladder-like bulging behind, (2) large bubbles dividing the membrane into segments.

H D: $1\frac{1}{4}$. Not changed by inflation, or, I should rather say, showing improvement for a second or two and then falling back again.

19*th.*—H D: $\frac{3\frac{1}{2}}{30}$. Membrane shows less dark coloring, and is not so indrawn. Posterior inferior segment markedly bulged. Color of lower part as in serous exudation. H D, after Politzerization, with head forward and to opposite side: $\frac{5\frac{1}{2}}{30}$. No signs of fluid after inflation. Patient to use air-bag at home, with head forward and to opposite side.

26*th.*—Has not been so well. H D: $\frac{1\frac{1}{2}}{30}$. Has been giddy. Air has evidently not entered at home. Membrane indrawn, no purple color, yellow tinge still present. Moist râles on inflation, and H D raised to $\frac{6}{30}$. Paracentesis, with egress of much straw-colored serum. H D: $\frac{6}{30}$. Great relief of "stuffiness about the head."

27*th.*—H D: R, $\frac{6}{30}$.

Blood at seat of incision, and membrane very slightly indrawn.

March 3*d.*—H D: $\frac{2}{20}$. Return of discomfort, giddiness, etc. Reaccumulation of fluid, paracentesis, and immediate relief, which I presume has continued, otherwise the patient was to return.

This case was obviously, in the first place, one of sudden hemorrhage into the tympanic cavity, and when first under observation the latter contained blood-clot and serum. The presence of the blood-clot was shown by the dark purple color of the membrane, which changed its character after inflation, thus proving its appearance to be due to hemorrhage behind the drum-head. The bleeding was easily enough accounted for by the increased pressure of the compressed air, the neglect to perform Valsalva's experiment before entering the chamber, and the presence of chronic naso-pharyngeal and middle-ear catarrh, all of which circumstances combined to place the intra-tympanic structures under a condition similar to that of the parts under an exhausted cupping-glass. The hemorrhage then, in this

case, goes far to prove the correctness of the view we have taken of the pathogenesis of otitis media hæmorrhagica; there are, however, some other points of interest in connection with the case, to which it may be well to refer shortly.

The fact that the patient could, by pressing upon the temple and parietal region, temporarily free himself from the uncomfortable feeling of intra-cranial tension, calls for remark, but is difficult of explanation. We must probably look upon this phenomenon as analogous to the cessation of tinnitus, which can sometimes be effected by pressure over the mastoid and seventh cervical vertebra, and also at times by blowing upon the cells of the external meatus; the explanation is probably to be sought in a vaso-motor connection.

Another point of interest was the presence of serous exudation before and after the absorption of the blood-clot, for I have no doubt that the yellow color observed above the upper margin of the purple discoloration (when the case was first seen) was due to the presence of serum. It must, I think, remain doubtful to which of the following causes the watery exudation was due, viz.: (1) hydrops ex vacuo; (2) irritant action of the clot; (3) absorption of the clot before the serum.

It is possible that the blood-clot may have been so placed as to prevent the passage of air into the tympanum, and thus have produced diminished pressure in the free part of the cavity with secondary serous exudation. This view was favored by the very marked and obstinate indrawing of the upper part of the membrane. The second hypothesis—that the serous exudation was due to the irritant action of the clot—does not seem probable, because there was no pain or other symptom pointing to inflammatory action. Absorption[1] of the clot before the serum is sometimes met with in apoplexy but not often; that it occurred in this case seems at first sight certain. It must, however, be remembered that inflation may have been each time followed by the absorption of a part of the clot and serum, while, whenever the supply of air so gained was absorbed, a fresh hydrops ex vacuo may have occurred.

[1] "A Manual of Pathology," by Ernst Wagner, p. 507.

THE USE OF BICHLORIDE OF MERCURY IN OTORRHŒA.

By H. L. FERGUSON, Dunedin, N. Z.

I HAVE for the past five years used the dry treatment almost exclusively for otorrhœa, and at home—that is, when I was in Dublin,—I was in the habit, when the powder used, whether boracic acid or iodoform, was caked or moistened with discharge, of syringing it out with warm water. Since I have been out here I have used a warm one-per-cent. solution of carbolic to syringe all ears in which the drum is not perfect, and am under the impression that my results are better.

Last October I was induced, by the glowing accounts in the British and American journals of bichloride of mercury as an antiseptic, to substitute a one-in-two-thousand solution of the bichloride for the carbolic.

I used it in about a dozen cases of chronic otorrhœa, and in several noticed considerable hyperæmia of the membrane subsequently, which in two cases went on to severe myringitis. In one case, a man of about forty, with a large perforation in front of the handle of the malleus and old-standing discharge, a slough formed behind the malleus, which separated, leaving a second perforation, which has proved permanent. In the other, a boy of eighteen had a small central perforation and discharge from childhood. The caked boracic acid was syringed out with the bichloride solution on the 3d and again on the 4th of November. Subsequently he had severe pain, and on the 5th had enormous swelling of the membrane, for which I had to incise it freely,

enlarging the perforation to the floor of the drum. Pus followed the knife from the membrane, and in his case the inflammation led to the formation of a false membrane, which united the edges of the perforation to the promontory and closed the old perforation. Both have been under observation before and since and suffered no irritation or inconvenience from the carbolic solution. In neither case was the hearing subsequently impaired, but they have to thank Sir Joseph Lister's optimistic praise of the new antiseptic for their attacks.

I am now using the carbolic, in which I always put some bicarbonate of soda, to raise the specific gravity of the fluid. I find that in ears with perforation of the *Mt*, where the Eustachian tube is free before syringing, if water or plain carbolic solution is used and passes down the tube, the tube is not, as a rule, free to Valsalva afterwards, owing to the swelling of the mucous membrane from absorption of the water. If, however, I raise the specific gravity of the solution with salt or sod. bicarb., the absorption does not take place and the tube remains free. Of course the same action takes place in the cavity of the drum as in the tube, but I am not aware of any one having suggested this simple precaution.

If I am writing rubbish, Mr. Editor, please put it behind the fire. I am so out of the world here that I feel as if I must be quite unable to estimate the value of a case or observation. I have frequently cases I should like to send you for publication, but always have a feeling that something may be going on I do not know of here, and that I am behind the age, though of course I am only six weeks away. I miss the reference libraries of the old country very much, and all the new books I get are, alas, in most cases, of little use except to make me feel that there is not so much being done after all.

WHOOPING-COUGH AS A CAUSE OF DEAFNESS.

By M. S. FALLS, M.D.,

ASSISTANT TO DR. BURNETT'S EYE AND EAR CLINIC, CENTRAL DISPENSARY, WASHINGTON, D. C.

FROM a careful examination into the predisposing and exciting causes of deafness, I was much impressed with the scant mention made of whooping-cough as an etiological factor. While our text-books and journals are very prolific in assigning the exanthemata, diseases of the larynx, and even gastritis as agents of causation, whooping-cough, beyond the few authorities given below, is entirely ignored.

I consider pertussis as probably not a rare cause, but in dispensary practice, from which most of the cases have been taken, the time given to each case for examination is so extremely limited, that the history elicited is, as a rule, imperfect, and inadequate to our wants.

Wilde, on "Diseases of the Ear," Phil., 1853, p. 495, cites five cases in which the deaf-mutism was considered the result of whooping-cough. He further says in this connection: "In what way whooping-cough produces deafness, whether by local injury to the ear, such as occurs during a violent paroxysm rupturing the membrana, or from its effects on the nervous system, I am unable to say. Every one is aware of the many anomalous consequences which follow pertussis and popularly denominated 'the dregs of whooping-cough.'" Roosa, 6th ed., p. 685, reports in his statistics two cases in which deaf-mutism was assigned to pertussis. Peet, J. M., New York, 1856, pp. 53–56, tabulates twelve cases of deaf-mutism due to whooping-cough.

That rupture of the membrane can occur from violent paroxysms of coughing I do not doubt, for several cases are recorded in which the violent strain from the cough has been followed by cerebral effusion, with paralysis as a result. But in the cases coming under my observation, and that of Dr. Burnett, Director of the Ophthalmological and Otological Clinic of the Central Dispensary, the membrane was intact in all. That the deafness may be due to extension of inflammatory action from the throat I also admit; for when we consider the relative vascularity of the membrane in children and adults, we will find that the blood supply to the former is much greater, and that whooping-cough, although considered by some writers with diseases of the larynx and trachea, is not infrequently attended with hyperæmia of the Eustachian tube and tympanum.

But in the cases which I present for consideration, we would not be warranted in ascribing all of them to an inflammatory extension from the pharynx; rather let us look for some nervous implication, as the deafness was in the majority of cases absolute, since neither the vibrations of the fork nor the ticking of the watch could be heard when applied to the teeth or cranium, or when held close to the ear. In view of the above we think that the following cases taken from Dr. Burnett's clinic will not be without interest:

CASE 1.—A. E., æt. eleven years. Admitted to the clinic at the Central Dispensary May 22, '85. The boy presented every evidence of scrofula, and had been treated for Pott's disease by Dr. S. W. Gross.

Twelve weeks ago, had pertussis attended with great straining. Two weeks ago hearing was suddenly lost, the deafness being absolute, commencing late in the evening, and, on the following morning, hearing in the left ear was lost. This was attended with some pain, but no discharge, vertigo, or vomiting. This pain persisted for two days, and then left the patient as suddenly as it began. *Mtt* intact, but slightly more concave than normal. Pyramid of light not visible to the periphery of the membrane in either ear. Put upon specific treatment. June 8th: Gives manifestations of tinnitus aurium. Complaining to his sister of "a

roaring" in his head. Since put upon specific treatment, some vomiting and nausea immediately after taking the medicine. Dose reduced one half. No improvement in hearing. Have seen the boy several times since, but so far no amelioration.

CASE 2.—S. B., æt four years. A mulatto boy, presenting every evidence of the scrofulous cachexia. On June 2, '85, when he was first admitted, his mother gave a history to the effect that, since March, he has had an attack of whooping-cough. Two or three weeks after the onset of the disease he suddenly became deaf (not absolute). Three weeks ago, discharge began in the right ear, none from the left. Complains of no pain. Loud voice at one foot, with either ear. Noticed unsteadiness of gait. *Mtt* slightly thickened and red. June 9th, less injection of membrana. Voice in either ear, one foot; probable increase of hearing after Politzer. June 9th, for two days pain in right ear. June 16th, gait normal; no pain; deafness persistent.

The following cases, of a similar character to the above, I report by the kindness of Dr. Burnett, from whose private case-book I copy the notes.

CASE 3.—M. J., white, æt thirteen years, had whooping-cough when about five years old. During convalescence, his parents noticed that his hearing power was defective. He became totally deaf within a year. No pain or discharge. *Mtt* normal.

It is of interest to note in connection with this case, and as bearing on the possible inherited tendency to deafness at a certain age, that a brother of the above had scarlet-fever at five years of age. No inflammatory affection of his ears, but his hearing gradually left him, and in twelve months he was completely deaf.

CASE 4.—H. S., white, æt. twelve, had suffered from impaired hearing, in right ear, as noticed by his parents since an attack of whooping-cough. Never any pain or discharge. L, W., fourteen feet; R, W., faintly on contact. *Mtt* normal; tubes pervious; no improvement after inflation.

The above cases occurred in Dr. Burnett's practice, in 1876.

The data furnished by these cases are not sufficient to

warrant any positive conclusion as to the causative relation between pertussis and deafness, or as to the manner in which the ear affection is brought about, but the existence of a connection between the two seems highly probable.

Cases 1, 3, and 4 would appear to be purely nervous in their character, while in case 2 there was a middle-ear complication, which, however, probably only served as a complication.

COCAINE IN "EARACHE."[1]

By A. G. HOBBS, M.D.,

PROFESSOR OF EYE, EAR, AND THROAT DISEASES IN THE SOUTHERN MEDICAL COLLEGE, ATLANTA, GA.

IT is the style now to use hydrochlorate of cocaine in all imaginable aches and pains, and were it not for the high price of the salt I have no doubt it would be used still more indiscriminately.

It is almost established now that its use should be confined to mucous membranes; at least, so far as my experience goes, it is useless to apply it to the skin, or even to depend upon its physiological effects when applied hypodermically.

The literature upon the subject is already profuse, notwithstanding the salt has only been in use about six months. In the last number of the ARCHIVES OF OPHTHALMOLOGY Dr. Knapp has given a summary of all that has been written about cocaine, showing the great variety of cases in which it has been tried. A physician lately said to me that he was greatly disappointed with cocaine, because he had used a strong solution in a case of "earache" without any effect. As well might he have rubbed the same solution upon the skin of the finger to ease the pain of a bone-felon. He had proceeded upon the principle that the external layer of the drum-head was mucous membrane, and not skin, and that the cocaine would penetrate the membrane and gain access to the lining mucous membrane of the middle ear—the seat of the pain in so-called earache.

[1] Since writing the above, some weeks ago, I have treated five more cases in the same manner, with good results in four.—H.

The case alluded to above was sent to me while the pain from an acute inflammation of the middle ear was still in its acute stage; the pain was almost immediately relieved by the application of cocaine—not through the external auditory canal, but through the Eustachian tube. Two drops of a two-per-cent. solution were blown through a warmed silver catheter into the tympanum; the pain returned, but in a less degree, in about two hours, when I inserted two drops of a four-per-cent. solution, which gave ease for eight hours; after this the pain was controlled by spraying a solution of cocaine and glycerine into the corresponding nostril, and immediately resorting to Valsalva's method of inflation. I have treated six other cases in almost exactly the same manner as the above case, and the desired result was gained in a greater or less degree in all. In one of these cases a tinnitus, that had existed about six months, from a previous inflammation, was entirely relieved. I do not say that the cocaine stilled the roaring in this case, but every aurist knows that in most cases a tinnitus is increased instead of diminished by a recurrent attack of middle-ear inflammation.

A CASE OF HYSTERICAL DEAFNESS, WITH REMARKS.

By JOHN F. FULTON, M.D.

PROFESSOR OF OPHTHALMOLOGY AND OTOLOGY AT THE MINNEAPOLIS COLLEGE HOSPITAL.

ALTHOUGH cases of hysterical amblyopia in which there is a diminished sensibility of the retina and optic nerves are occasionally met with, cases of hysterical diminution of the functional activity of the auditory nerves seem to be extremely rare. In fact, many of the best text-books fail to mention the subject, and others hint at it in vague terms. My attention has been called to the subject by a case which came under my care in private practice some months ago, which I think of sufficient interest to be reported in detail, as it opens up comparatively a new field for investigation, and calls to our mind another factor in the consideration of the treatment of maladies of the ears and their appendages.

On the 20th of May, 1884, Mrs. H., aged thirty-six, called at my office complaining of being quite deaf, and that it had come on quite suddenly. She was referred to me by her sister, who I had treated successfully for chronic suppuration of the middle ear. Seeing at a glance that my patient was of a highly nervous temperament, pale, and quite anæmic, I began by making inquiries as to her constitutional trouble, which brought out the following history :

The patient has always been subject to violent mental emotions —fits, laughing, crying, sobbing, with elevation and depression of spirits. There are frequent contractions of the various groups of muscles and sense of constriction at the pit of the stomach—well marked. She complains that she has been very much annoyed

with palpitation of the heart, and speaks of a long train of nervous symptoms—all hysterical in their nature and all exaggerated by the patient. One day the patient comes to the office complaining of one set of symptoms, the next of another.

The history of the case showed, however, that the paroxysms of hysteria were not so prominent as the extreme susceptibility of the nervous system. While under treatment this showed itself constantly from day to day. There was no suspicion of this lady's trouble being feigned. She was most anxious to be relieved. A careful examination failed to reveal organic disease of any organ.

Two years previous to the date of the patient's first visit to my office she had an attack of ear trouble similar to the one that now annoys her. The deafness came on suddenly, associated with slight dizziness, but could hear some days much better than others. Some days it would require loud shouts of the voice to be heard, other days she could hear the tick of a watch. Her general health was very poor at the time. She applied to the late Dr. Atwood for treatment. He evidently had treated her for chronic catarrh of the middle ear. She derived no benefit from the treatment. Went to the country for a few weeks, and returned with her acuteness of hearing normal and general health much improved. She came to my office, as above stated, complaining of her second attack of aural trouble. It came on as in the former case, with all the symptoms worse. The dizziness and tinnitus very distressing. There is no pain. It cannot be noticed that there is any difference in the ears. Their acuteness of hearing is the same. The watch cannot be heard on contact with either ear. For the voice the acuteness of hearing is about one half that of normal. Politzerization improved the hearing very little, if any. The examination of the external canal and ear drum and adjacent parts gave negative results. There was a slight catarrhal condition of Eustachian tubes and middle ear, but not sufficient to account for the trouble. There was no amblyopia; no motor or sensory paralysis. The "come and go" hearing being like the "come and go" vision of hysteric amblyopia, was a marked feature of the case, and could only be accounted for on the basis of hysteria.

After the patient had been under my observation for some days, and seemed to be much improved, she came into the office one morning more deaf than ever. The day before some domestic difficulty had arisen which gave rise to excitement on the part of

our patient, and thus produced the dulness of hearing. A few days later she was feeling much better, the spirits were hilarious, and the acuteness of hearing became almost normal. During the attacks of dulness of hearing the bone-conduction was very much diminished, and at one time seemed almost absent. It ceased considerable sooner than the aërial conduction. The application of the galvanic current always improved the hearing, but this was the only therapeutic agent that seemed to have any appreciable effect. Nutritious food, cheerful company, and plenty of open-air exercise gave valuable assistance in bringing about a favorable result. This was indicated by the complete removal of the subjective noises, the improvement in the acuteness of hearing, and the very great change of the general health for the better.

It should have been stated earlier in the history of this case that there were times when sounds seemed abnormally loud to the patient, and the ordinary tones of conversation would annoy her. These would come on first, and would be followed by depression and the lower condition of sensibility of the auditory nerve. She had some trouble with the uterus, and commenced to have it treated while under my care, and claimed to improve much more rapidly after this.

Cases of true hysterical deafness must be extremely rare. Dr. Burnett, in his work ("A Treatise on the Ear"), in speaking on this subject says: "Dr. S. Weir Mitchell has called my attention to what he terms hysterical deafness. In the case of a young woman he observed a deafness which would apparently come and go during conversation. At other times the patient would fail to hear under circumstances in which she had but a short time before appeared to hear well. I have never observed such a case, but I doubt not that such should be classed under hysterical phenomena." Dr. A. Magnus, in *Arch. f. Ohrenheilk.*, has a paper on "A Case of Complete Transient Deafness," in which, after referring to the different possible diagnoses, he pronounces it a case of hysteric deafness. But the literature on the subject is quite scarce. Politzer says: "Peculiar sensations in the organ of hearing are not uncommon in hysterical subjects. Patients complain frequently of a constriction and pressure in the ears, of

purling, gushing, and crawling in the interior of the meatus, and of increased sensibility to noises without any perceptible disturbance of hearing. On the other hand, deafness of undoubtedly hysteric character is very seldom met with, according to the observation hitherto made, perhaps even more seldom than hysterical amblyopia."

Walton has made some interesting observations on this subject. In a paper of his published in *Brain*, on "Deafness in Hysterical Hemi-Anæsthesia," he points out that in total hemi-anæsthesia the *Mt* can be touched without pain, and the sound-perception is reduced on the affected side; neither could the entrance of air into the middle ear be felt on this side. In the partial hemi-anæsthesiac all these symptoms were noticed, but in a less marked degree. In the bilateral cases of anæsthesia which Walton examined, there was bilateral deafness corresponding to the degree of the loss of sensation. In all of the cases the aërial vibrations of the tuning-fork were better perceived than bone-conduction.

The relationship of hysteria with all the organs of special sense is a very interesting study, but it is extremely difficult in ophthalmic and aural practice to separate the true hysterical symptoms from those having a distinct pathological basis. Hence the great care with which these cases should be studied and the importance of a detailed report of all such.

Interesting, too, in this connection is the influence of diseases of the uterus on diseases of the ear. It will be remembered that as soon as the patient's uterine trouble was treated her ears improved more rapidly. Weber-Liel has written a paper on this subject in the *Monatsschrift für Ohrenheilkunde*, in which he says the affections of the sexual organs of the female, and even the physiological accomplishment of their principal functions, produce a marked effect on diseases of the ear. When pregnancy, flexions of the uterus, etc., occur in the course of ear disease, the progress and character of the latter are markedly modified. A simple catarrhal otitis, which is often insignificant, may become complicated with considerable disturbance of the

nervous and circulatory systems, and the treatment of the ear disease becomes useless as long as the abnormal condition of the reproductive organs is maintained. When that is relieved, the affection of the ear is healed in turn. In the case which I have here reported the trouble with the uterus was a complication, and not the cause, of the deafness. But the influence of the other organs on diseases of the ear is one that is too little thought of, the importance of which is amply shown by the careful study of cases such as this one and those pointed out by Weber-Liel.

RESTORATION OF THE CLOSED FAUCIAL APERTURE BY REPEATED OPERATIONS UPON THE SOFT PALATE.

By WILLIAM B. WOOD, M.D., of New York.

(*With three wood-cuts.*)

William McD., age eighteen, was brought to me in April, 1884, on account of his inability to articulate and breathe through his nose. On examination the condition shown in fig. 1 presented itself. Upon elevating the uvula, a small aperture, one line in diameter, appeared, as in fig. 2, and was the only communication between the naso-pharynx and the throat. When four years old he was very ill with what was said to be scarlet-fever, and a very bad throat. The well-defined lines of cicatricial tissue established the fact that the soft palate grew to the posterior wall of the pharynx during this illness. The hearing was normal, and the appearance of the drum membranes fairly good.

The difficulties in operating in these cases have been found to be from hemorrhage; from the remarkable persistency and rapidity with which the cut surfaces grow together; from the fact that in articulation the soft palate must have a certain definite relative position to the surrounding parts, must support the uvula, and possess a definite power of motion with a good degree of flexibility. It would be comparatively easy to give a good breathing aperture, but to secure a soft palate and posterior pillars, that make articulation possible and speech intelligible, requires the utmost caution, a maximum of patience, and constant practice of vocal calisthenics.

It was decided to attempt to attain a successful result in this case by a series of small operations, combined with constant training in the hands of a specialist in articulation.

After two hundred and fifty sittings during fourteen months,

the result seen in fig. 3 was obtained, giving the patient the ability to breathe and articulate with entire success.

The vocal training was actively pursued during the entire fourteen months, and reports of the patient's progress in articulation made after every operation, thus enabling me to determine how far and in what direction to operate. The greatest difficulty experienced was in keeping the cut surfaces apart so as to prevent reunion.

Another difficulty encountered in this case was the mental deficiency of the patient—his father being a victim of alcoholismus,—and the fact that he could not be relied upon to use his newly acquired power except when compelled to. It is probable that a good deal of contraction will occur again, due to this failure on his part, and this may necessitate a further series of operations later on.

Miss WARREN undertook the vocal training of the patient, and has kindly written the following account of the methods pursued :—

Various experiments have proved conclusively that pure vowel sounds can be made only when the soft palate is raised, its edge being in contact with the posterior wall of the pharynx, or very nearly so. A wire of the size of a strong thread has been carefully introduced through the nose until one end could be seen below the soft palate ; when the outer end was moved, the part hanging down the pharynx could be seen to sway from side to side. When pure vowel sounds were given (*ee*, as in see ; *a*, as in pay ; *o*, as in no ; *oo*, as in poor ; *a*, as in father), no motion could be produced, the contact between the soft palate and the posterior wall of the pharynx being so perfect that the wire was held fast. A thread, with the help of a small tube, was inserted in the same manner as the wire ; both ends were pulled, the effect being to slightly remove the soft palate from the wall of the pharynx, the vowels being again uttered ; at first no change was observed, but at a certain point, (roughly speaking at an aperture of .045 sq., in.) the nasal intonation became suddenly perceptible.

If the opening be made larger by swollen tonsils interfering with the elevation of the soft palate, by the bad habit of an individual of not raising the latter sufficiently, or on ac-

count of a "cleft palate," the nasal peculiarity of the voice may increase from a "twang" to a complete change of sounds, rendering speech unintelligible. This has all been proved in my experience in overcoming defects of speech, and in teaching correct articulation to persons having artificial palates. Three consonants only—*m*, *n*, *ng*—are formed by allowing the voice to pass through the nasal passages, the soft palate falling upon the tongue; these are capable of

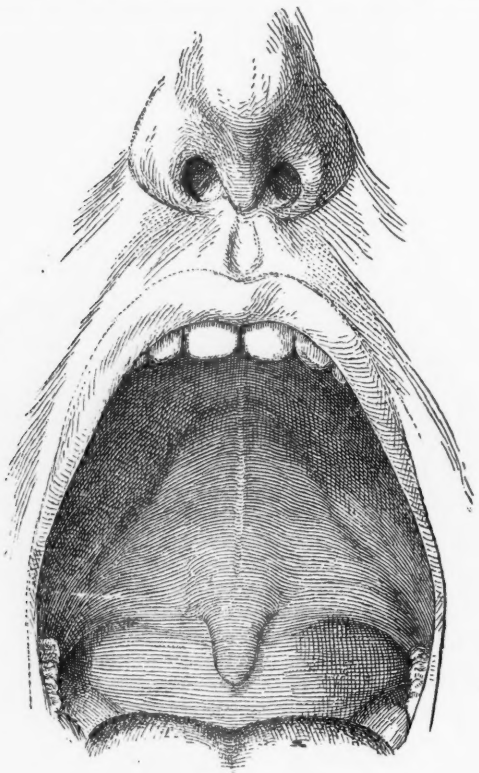


Fig. 1.

being prolonged during an entire expiration. The slightest tinge of nasality in a vowel or in any other consonants than those mentioned above is objectionable in our language; thus the action of the soft palate must be constant and prompt.

In the case under consideration, the soft palate being fastened back (see figs. 1 and 2), could not act properly during articu-

lation, and the breath found no outlet through the nose ; in consequence, the three nasals—*m*, *n*, *ng*—were muffled and scarcely noticeable ; the mouth was used for both currents of breath, the inspired and the expired, causing frequent breaks in a sentence of a few words ; the boy was unable to blow his nose ; and all the vowels that require an expansion of the soft palate accompanying the action of the tongue, were necessarily lacking in purity. The movements of the tongue itself were sluggish ; this was not wholly due to the condition of the palate, however, but to lack of effort on the part of the boy. *S* and *th* were the only elements of the language that he could not give when not combined with other sounds ; but when he attempted to speak a syllable or a sentence his speech was unintelligible.

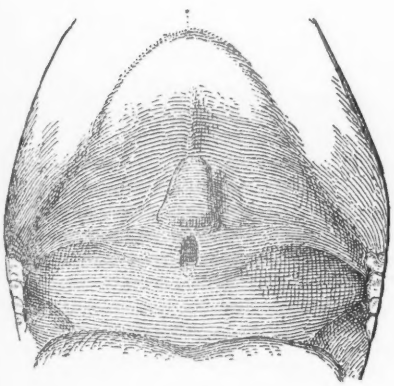


Fig. 2.

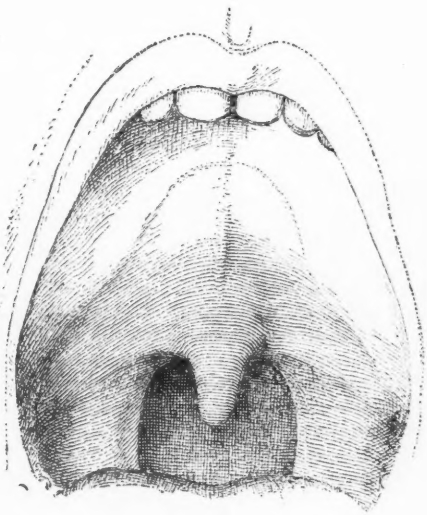


Fig. 3.

Fig. 3 shows the present appearance of the palate. The breath has a proper outlet through the nose ; the nasals are given clearly and can be prolonged ; the mouth need no longer be used for the inspired current of breath ; the boy can blow his nose properly ; and he can read and speak distinctly. On Feb. 7, '84, I first gave him a drill on the elementary sounds and other exercises for the purpose of training his tongue to prompt and correct action. By May 9th he spoke clearly, but with an effort. His lips were without strength ; he could not hold them together unless he supported his chin. After Nov. 3, '84, lessons were given daily.

Breathing exercises were begun, and the drill on elementary sounds continued. The first indication of the working of the soft palate was noticeable on Nov. 13th. The operations did not cause a soreness sufficient to interfere with his speaking and reading.

Nov. 19th.—A marked change in voice and speech—a deeper tone and clearer utterance. The boy's mouth is closed most of the time.

Nov. 24th–29th.—Great improvement. Resonance of the nasal cavity quite apparent, making a decided change for the better in his voice. On Feb. 7, 1885, the pupil could read a long sentence without a break.

From Nov. 3, 1884, to the middle of May, 1885, I gave the pupil a series of exercises which required action of the soft palate and the lips, and strengthened the nasal current of voice. The breathing exercises were given for the purpose of making use of the increased size of the opening and overcoming the habit of mouth-breathing. After Dec. 1, '84, the boy slept with his mouth closed.

TOTAL REMOVAL OF AN IVORY EXOSTOSIS WHICH COMPLETELY FILLED THE EAR-CANAL.—RECOVERY.

By H. KNAPP.

THE subjoined communication, though being the report of one case only, may not be found devoid of interest, on account of the unusual difficulties and the complete result of the operation. The plan of the operation, which has proved successful in the removal of ivory osteomas from other localities, may, perhaps, be developed into a general, I do not mean exclusive, method for the removal of osteomas from the external ear-canal. The history of the case is as follows:

L. R., æt. thirty-eight, a Swede, had scarlet-fever when he was four years old, and from that time otorrhœa on both sides, with varying intensity, all his life. He is a strong, healthy man, free from any inherited or acquired dyscrasia. He consulted me first Dec. 18, 1872. He then had pharyngitis, polypi filling the left external ear-canal, perforation of the right *Mt*, and swelling of the adjacent walls of the canal. I removed a part of the polypi at once, and the rest, under chloroform narcosis, five days later. Small granulations, which showed themselves afterward, were treated with an alcoholic solution of sulpho-carbolate of zinc. The promontory was touched in both ears with a probe and felt normal. The discharge continued in both ears to a certain degree, his hearing was impaired, but he could attend to his business without difficulty. Three years later he consulted an aurist in Paris, who told him that nothing could be done for him. His hearing became gradually worse.

On Sept. 11, 1884, he came to me in great distress. For three days he had had the most intense pain in and around his right ear, radiating through the whole right side of his head, and depriving him of sleep. For three days the discharge from that ear had stopped. The right ear was filled with polypi, which I at once removed, and told him to put alcohol and boric acid in his ear. The left ear showed the same condition, but in a less degree, and it did not pain him. There were exostoses in both canals. Watch not heard. V R $= \frac{1}{\infty}$, L $= \frac{1}{60}$.

The next day I found that the treatment had not diminished his distress. The pain was unabated. There was scant discharge in both ears. On careful examination it was discovered that the internal portion of the right ear-canal was completely filled with a hard, round tumor, of bony feel, covered with thin, red skin. Its broad basis was situated on the posterior wall of the canal, the rounded crest pressed against the anterior wall so firmly that not even a probe could be introduced between tumor and wall. On the upper and lower sides a probe could be forced in to a depth of a few millimetres. The eyes, examined with the ophthalmoscope, were found normal. The right mastoid process was neither tender nor red.

My opinion was that the mastoid, if not sclerosed by the chronic inflammation, was the seat of retained pus; in any case the secretion from the tympanic cavity was stowed back by the plugging of the ear-canal. To make an opening, by a drill or otherwise, and let the secretion out, was the immediate indication, but I thought the exostosis might be removed as well now as later, and the patient be spared the disappointment from half-measures. He, seeking relief from his excessive headache, willingly consented.

The operation was done at the N. Y. Ophthalmic and Aural Institute, Sept. 12, 1884. As soon as the patient was etherized —which took three minutes—I made with a scalpel an incision through the skin, along the posterior wall of the canal, corresponding to the base of the tumor. Hard bone was laid bare. The incision was made wider by dissecting off the adjacent skin. I applied a very sharp, small chisel to the base of the tumor, hitting it with a mallet in order to find out whether the tumor was attached to the bone by a base of softer bone substance. This is not infrequently the case in osteomas of the orbit and its neighboring cavities. I applied the chisel along the whole base of the tumor, close to the osseous wall, from which it sprang not

quite abruptly, and hammered for some minutes, but the tumor did not yield. Then I chiselled a groove into the tumor at its base. This brought the dense ivory structure of the growth to view. The progress into the depth that I made in this way was discouragingly slow. I therefore divested the whole anterior surface of the tumor from its integument, and chiselled a portion of the superior and inner periphery of the tumor off. I could now introduce probes and small hooks behind the tumor. Availing myself of the space gained, I put the bent portions of different hooks behind the tumor and tried to move it forward. All those instruments broke. I made an attempt to grasp the apex of the the tumor with Sexton's foreign-body forceps. A branch broke off like glass. Patiently I chiselled deeper into the tumor at its base until a solid piece (*a* in figure on page 126) about the size of a large pea was removed. The whole basal portion, however, was left. Though the canal was now open again, I concluded to remove also the basal portion and restore the whole calibre of the canal.

In removing the broad and very hard basal portion, *I no longer attacked the tumor, but the tissue in which it originated,* chiselling into the bone of the ear-canal. This bone proved less dense than the tumor, and I made far better headway. After some time the mass could be slightly moved with a strong pair of forceps. I continued chiselling around it, posteriorly, above, and below, until I could, not without considerable force, twist out a solid piece of dense bone to which a portion of the bony canal was attached. This cleared the canal, but its walls were ragged and rough to a large extent, also where the instruments had not touched. The whole posterior wall was bare.

During the operation the canal was frequently syringed with a warm solution of boric acid and wiped out with absorbent cotton-wool. After the operation, when the hemorrhage, which was very moderate all through, was arrested, some boric-acid powder was put in the canal and covered with absorbent cotton. The patient had considerable pain at night, both in the wound and his head. There was no swelling, no irritation, but the ear discharged a great quantity of thick, somewhat offensive, evidently old pus.

During the next days the pain continued, the discharge diminished; there was no swelling. Iodoform was put into the canal. September 23d, eleven days after the operation, the patient left the hospital. The condition of the wound was good, he had no

fever, but his headache was still present, though not quite so intense.

At the front of the wound rough bone became the starting-point of vigorously spouting polypi, which I had to scrape out every three or four days. This caused considerable pain, but as soon as the news of the discovery of the anæsthetic action of cocaine reached New York, Oct. 11, 1884, I used it in his ear—dropping a 4 % solution on the granulations—and the scraping, now almost painless, could be done much more thoroughly.

Five weeks after the operation a piece of necrosed bone was removed from the posterior wall, and two weeks later another one, together with the malleus, of which the tip of the manubrium was missing. These pieces of bone (*c* and *d*, figure on p. 126) had been the starting-points of the granulations; they had been loose for some weeks, and were easily drawn out. When the last came out it was followed by a large quantity of thick pus, and a free opening led into the cavity of the mastoid process in which the pus had been stowed up.

From that day the patient was free from his stunning headache, and said he was another man. There were no more granulations. He was directed to syringe his ear with a weak solution of boric acid, or corrosive sublimate ($\frac{1}{10,000}$). He came to see me from time to time, and attended regularly to his business. The discharge continued moderate.

Feb. 2, '85, there was still a deep depression in the bone, filled with pus.

The condition of the left ear had considerably improved. When the patient came to see me, Sept. 11, '84, on account of the headache and pain in his right ear, I examined the left ear also and found two mamillary exostoses, the larger on the anterior, the smaller on the posterior wall. They touched each other near the centre, leaving a small space in the upper part free. There was some purulent discharge, and the skin of the meatus was swollen. This was the ear with which the patient could understand people when they spoke directly to him while he was pressing the auricle forward. He could not hear the watch. This ear was syringed twice daily with a solution of boric acid. Feb. 2, '85, there was scarcely any discharge from that ear, the skin was no longer swollen, and he could understand my voice across the room ($V = \frac{20}{60}$). With the right ear the hearing for the voice was $V = \frac{8}{60}$.

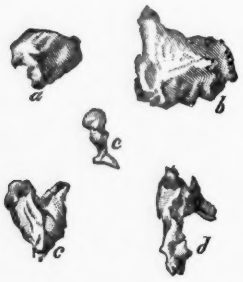
I had not seen the patient for some time, and was surprised that in the right ear-canal, near the tympanic cavity, *a membrane had formed that stretched transversely, at right angles, through the canal.* It was a continuation of the skin lining the canal, was smooth, slightly red, and had a central round aperture about 3 *mm.* in diameter. Touched with a probe, it was elastic but firm, and when I introduced a cotton-holder, mounted with some cotton, through the aperture, I met with a bony resistance (promontory) about 5 or 6 *mm.* behind the membrane. Withdrawing the cotton-holder, the membrane was drawn forward, and the little cotton plug, which came out with a click, had dipped up some mucus in the tympanic cavity. In a few days the central opening in the diaphragm had became larger ; I again dipped some mucus up, and directed the patient not to syringe his ear, but to wipe it out with cotton wound on a match, if there should be any discharge. There was none, and when the patient, some weeks later, came to see me again, *the transverse pseudo-membrane had disappeared without a trace, just as misteriously as it had put in an appearance.* The canal was of normal width, and lined everywhere with healthy skin. The inner wall of the tympanic cavity lay open to view, the *Mt* being absent. The mucous membrane was red, but not thickened. During syringing the water ran into the throat.

May 5, 1885.—Conditions materially the same. Still a little discharge from the ears. They show the effects of bad weather. No pain ; $h = \frac{P.}{24}$, (watch of 24 inches hearing distance heard when pressed against the ear, also from mastoid and temple). L E, the same, but fainter. Tuning-fork heard through the air, and through the bone from every part of the skull. With a flexible tube the lowest whisper is heard ; $V = \frac{20}{60}$ each ear.

July 22, 1885 I asked the patient to let me examine him again. The condition was materially the same. He had suffered from the excessive heat we had had at that time. In his right ear the hearing was $V = \frac{20}{60}$—, *i. e.*, I had to raise my voice somewhat to be understood at 20′ ; in the left $V = \frac{10}{60}$; $h = \frac{P.}{24}$ (pressed on the ear), from mastoid and temple the same, fainter in L than R E.

REMARKS.

1. The size of the *pieces of bone* are given in the accompanying drawings in their natural dimensions.



a is the ivory exostosis which projected into the canal and was first chiselled out.

b, the basal portion of the exostosis with that part of the osseous wall in which it originated.

c and *d* are portions of dead bone which were situated in the mastoid cavity, at the side of the exostosis.

e, the malleus, without the tip of the handle, such as it was exfoliated.

2. The *pathogenesis* of the case is clear. Chronic otitis media had led to periostitis, caries, formation of polypi, and exostosis in the course of thirty-four years. When the exostosis in the right ear occluded the canal completely, the secretion was kept back, and the symptoms were those of retained pus in the mastoid. The local changes of the mastoid were, however, so insignificant that I thought the tympanic cavity was the chief locality of the retention. Moreover, I thought that it was more likely that the mastoid in the course of years should have been sclerosed, especially as there was so marked a new formation of bone in the canal. The history of the case showed that I was mistaken. Two pieces of dead bone were situated on the anterior side of the process, near the posterior wall of the ear-canal. These pieces, before necrosis took place, must have been carious, and given rise to the formation of polypoid granulations on the one hand and to hyperostosis on the other, a process with which we are all familiar.

3. If I had been able to make a correct diagnosis, I would have *operated* in an entirely different way. I would have chiselled the mastoid open close to the insertion of the auricle, which would have given me access to the sequestra.

Through the same opening not only the sequestra, but the exostosis might have been removed.

4. If we are not sure of the presence of mastoid disease, or if an operation shows that the mastoid is sclerosed and an operation for exostosis becomes necessary, a hole bored through the bone with a dentist's drill, as Mathewson and a few others have done, may afford immediate, and perhaps permanent, relief, but when the radical removal of the exostosis is intended—which seems to me more desirable in most cases,—I would do it from the beginning in the manner in which I removed the basal portion of our specimen, namely, by attacking the mother tissue, which is softer than an ivory osteoma. There is no particular danger in breaking down a part of the osseous wall of the ear-canal. The only vulnerable neighborhood is that of the glenoid articulation. This will, however, rarely come into question, as exostoses seldom spring from the lower wall. The frequency of the origin in the posterior wall evidently points to mastoid disease as the primary affection.

5. The removal of the exostosis under consideration was one of the most difficult operations I have ever performed. I am somewhat familiar with the difficulties in removing osteomas from the orbital and nasal cavities and from the frontal sinuses, but they are surpassed by those in the ear-canal on account of the narrowness and darkness of the field in which we have to operate. It took me an hour and twenty-five minutes to complete the above operation, but the result, I think, was a brilliant reward of my patience and perseverance. As far as I have perused the literature of the subject it seems that almost all operations undertaken for the removal of exostoses from the ear-canal have not been completed. It remains to be seen whether the method of sub-periosteal enucleation, so brilliantly inaugurated by Maisonneuve for these tumors in the nasal cavity, and successfully applied by myself to the frontal sinus, could not be made available also for the extirpation of exostoses in the ear-canal.

A MALFORMATION OF THE EAR.

By C. TRUCKENBROD, of Hamburg.

Translated by Dr. J. B. McMahon, of New York.

ASSISTANT SURGEON NEW YORK OPHTHALMIC AND AURAL INSTITUTE.

(*With four illustrations on plate ii.*)

MALFORMATIONS of the ear have long since claimed the attention of observers. Lincke, in his text-book on otology,[1] has made a careful collection of all the cases observed up to his time. He mentions none, however, similar to the one I am about to describe. More recently Schwarze[2] has given a complete summary of the malformations thus far reported. On page 31, under the head of defective formation of the external auditory canal he writes: "Complete absence of the auditory canal occurs with absence or an undeveloped condition of the auricle, and with congenital defect of the drum-membrane." The case is described in *v. Ammon's Zeitschrift für Ophthalmologie*, vol. v., p. 4.

Graunitz[3] also describes a case which bears a striking similarity to ours. He states (p. 454) that Mrs. Buthke had a marked obliquity of the face, causing considerable disfigurement, existing from birth, or at least as long as she could remember, and accompanied with an imperfect development of the auricle on the left side and complete closure of the

[1] Vol. i., p. 582. Leipzig, 1837.

[2] "Pathological Anatomy of the Ear," in "Klebs' Manual of Pathological Anatomy," vol. ii., part 2. Berlin, 1878. Translated into English by J. O. Green, of Boston.

[3] Contribution to the Study of the Depressions at the Base of the Skull.—*Virchow's Archiv*, 1880, vol. lxxx., p. 449.

corresponding auditory canal. The autopsy showed a well-developed right auricle; the left was small, with a very large helix projecting forward. The antihelix and scaphoid fossa were wanting. The lobule was divided into two parts by a cleft.

Behind the very small articular fossa for the lower jaw and in front of the mastoid process is a somewhat depressed surface of bone, showing a row of small grooves for vessels; but no trace of an auditory canal exists. These grooves lead to large mastoid cells, which occupy the place of the external meatus. The middle ear is very small; it communicates with the pharynx through the Eustachian tube. No drum-membrane can be recognized. Of the small bones, the stirrup is quite normal, the incus pretty regular; to it is attached by a bridge of bone a small rudimentary malleus, recognizable only by means of a lens. The cochlea and semicircular canals are normal. The inner auditory canal opens into a large cavity.

Cock[1] describes a case of congenital dilatation of the tube, its lumen being three or four times the normal.

In our case the malformation was right-sided, and even from a casual examination of the face it was to be seen that some failure in the development of the side of the face and skull had occurred. The patient, a woman of sixty-three years, for æsthetic purposes, always kept one half of her face covered. According to her statement, she had never heard the slightest with the right ear. She had once come under treatment for severe epistaxis, on which occasion the defect was observed. She died suddenly after a sickness of two days.

Autopsy revealed: Chronic endocarditis of mitral valve. Cardiac hypertrophy. Emphysema and brown induration of the lungs. Venous congestion of kidneys, spleen, and liver.

The petrous bone was sawed away and its examination resulted as follows: The right auricle (fig. 1) is pear-shaped, the thick, clubbed end directed downward, the pointed part upward. The helix is seen as a swelling running from

[1] *Medico-chirurg. Transactions*, London, vol. xix., p. 161.

below upward; its length, 4 *cm.* Above, it ends in a somewhat rounded club-shaped extremity. A rudimentary antihelix can be made out. The tragus is a conical projection, 0.5 *cm.* high. The antitragus is not well marked. The lobule itself is a thick, shapeless swelling, bearing only a remote resemblance to the normal structure. It is 1.2 *cm.* in height and thickness; in breadth, 0.5 *cm.* The concha proper is a spherical cavity, the entrance to which is a long slit-like cleft, having a vertical direction. The cleft is at the same time somewhat curved in the shape of an S. Its height is 2.5 *cm.;* its breadth, 0.3 *cm.* The depth of the cavity is 1.5 *cm.;* its greatest diameter (vertical) measures 2.7 *cm.*, its horizontal diameter 1.5 *cm.* A small diverticulum, measuring in depth 0.3 *cm.*, and in width 0.4 *cm.*, extends from the lower part of the cavity. The cavity has no other extensions, and is formed exclusively in the cartilage. This cartilage may be regarded as the cartilaginous part of the external ear. Of an osseous auditory canal (external) there is no trace. The whole mass is fastened to the squamous portion of the temporal bone by connective tissue. The connection is not so firm as to prevent moderate movements in any direction. The entire auricle was carefully dissected and removed from the bone. In searching for possible remnants of the external auditory canal or drum-membrane, a vessel (fig. 2, *a*) of medium size was found running in the direction of the zygomatic process. On tracing its course, it was found to pierce the bone and run along the upper aspect of the petro-squamous fissure. The fissure itself showed a small groove for the reception of the vessel. With the vessel, strong bands of connective tissue extended through the fissure to the outer surface of the bone.

Kirchner has drawn attention to the practical importance of this vessel on account of its liability to be involved in inflammatory processes or in injuries. Before him, Zuckerkandl also had described this anomaly (of 280 skulls occurring in 22), and had remarked the developmental relations of its formation. According to Kölliker,[1] this

[1] "Elements of Embryology," 1880, p. 371.

vascular connection between the outer surface of the temporal bone and the interior of the cranium is constant in the embryo and disappears later on. The persistence of this anastomosis, which may exist in the fully developed temporal bone, as Luschka has shown, reminds one of the condition of the embryo in which the original transverse sinus penetrates the cranium at the place in question, the aperture becoming closed later on, and the internal jugular vein springing from the lower extremity of the primitive jugular.

Moos has shown that in phlebitis and thrombosis of the lateral sinus, the persistence of this anomaly may be the occasion of œdema in the temporo-zygomatic region.

The articular surface of the temporal bone for the lower jaw is very flat; there is no posterior articular process. The stylo-mastoid foramen is present (fig. 2, *b*), and also the Glaserian fissure, through which strong bands of connective tissue extend into the tympanum. The mastoid and styloid processes are well developed.

The Eustachian tube (fig. 3, *a*) is present. It has a very large, quite uniform lumen. Its vertical measurement, where it opens into the drum cavity, is 4 *mm.* An isthmus proper does not exist as the tube measures 2 *mm.* in diameter at its narrowest (the junction of the long and cartilaginous parts). The entire length of the tube is 2.4 *cm.*, of which 1.4 *cm.* belongs to the bony part. The tensor tympani muscle exists; its tendon is attached by a broad extremity to the malleus and incus. The tympanic cavity appears as a considerable expansion of the extremity of the tube. It is 6.5 *mm.* high, 9 *mm.* long, and 3 *mm.* deep. The examination of the tympanum showed no trace of the drum-membrane. Solid bone is found in the normal situation of the membrane. The stapedius muscle is present. Its tendon is inserted into the stirrup at the normal site. The mucous membrane of the tympanum is somewhat thickened. The stirrup is firmly fastened to the oval window by connective-tissue bands which allow of scarcely any perceptible movement. Its shape is quite normal (fig. 4, *a*), but stretched between the crura is a thin,

firm, bony plate. The incus is present, its two processes being very short and rudimentary (fig. 4, *b*). Ossiculum Sylvii present, attached to the head of the stirrup. Of the malleus, only the head exists. Its articular surface is united to the incus by bone, the joint being absolutely immovable. The bulb of the jugular vein is very large. The sigmoid sinus is present. A vein which connects the transverse sinus with the veins of the middle fossa passes through the front part of the upper border of the petrous bone, at a distance of 8 *mm.* from the squama. The superior semicircular canal is very prominent, greatly projecting into the interior of the skull. The cochlea and membranous semicircular canals are normal.

CEREBELLAR ABSCESS IN CHRONIC PURULENT OTITIS—EXTENSION ALONG THE FACIAL NERVE.

By HERMANN ROTHHOLZ,

AURAL SURGEON TO THE OPHTHALMIC AND AURAL HOSPITAL, GLEIWITZ, U. S.

Translated by Dr. J. B. McMahon, New York.

Peter Wanoth, æt twenty, employed in a foundry in Upper Silesia, was admitted to the hospital on October 6, 1884. On admission, he complained only of severe headache in the vertex, said to have lasted fourteen days. An otorrhœa had existed for five weeks, according to his report. His statements were not reliable, however, on account of the blunting of his mental faculties.

He understands moderately loud words uttered near the ear. The right auditory canal shows nothing out of the way. On the right side the drum-membrane is entirely destroyed, and the tympanum is filled with a mass of small polypi, deeply situated among which is a pulsating drop of secretion. The amount of secretion is trifling. The facial nerve, so far as it supplies the muscles of the brow and lids, is paralyzed. Patient states the inability to close the right eye has existed eight days. Still, no obliquity of the uvula is to be made out, nor is there any loss of power in the muscles of the soft palate, a circumstance which is worthy of special notice in consideration of the results of the autopsy. The fundus of the eye is normal, not even a marked hyperæmia being observed. Temperature 38.5°; pulse is strong, regular, rather frequent; after removal of the polypi so far as they could be reached by the snare and evacuation of the secretion by catheterizing the tube, *the patient can close the right eye almost completely.* In the further course of the disease, the fever was inconsiderable.

The temperature rose once to 39°, but after two doses (2 grammes) of antipyrin, fell to the normal, leaving the patient comfortable and quite free from the distressing headache. There was some constipation, the abdomen was hard and retracted, the patient felt dizzy on sitting up, and several times passed urine involuntarily. The discharge of pus from the right ear was very profuse from the day of his admission.

On Oct. 11th the stupor increased, a mild delirium supervened, followed on the morning of the 12th by sudden stertorous breathing, complete loss of consciousness, divergent strabismus, light convulsions of the upper extremities, pulmonary œdema. Death occurred on the same evening. On the preceding day some patches of herpetic vesicles appeared on the right cheek. On the day of the death the right cheek was dotted over with them.

The AUTOPSY was made thirty-six hours after death.

The description of the right temporal bone, which was removed for a later and more careful examination, is given below.

The dura mater was much congested, and attached by exudation to the pia in a few spots; otherwise it was normal. There was purulent lepto-meningitis, especially at the base, beginning in front at the chiasm and extending posteriorly to the envelopes of the medulla. A few small stripes of exudation ran up on the convexity along the vessels of the pia mater. The anterior portion of the pia, on the lower aspect of the right cerebellar hemisphere, is of a dirty green color. In the right cerebellar hemisphere, and partly also in the lower vermiform process, are two abscesses, of about the size of a walnut, filled with greasy pus. They communicate with each other, and are surrounded by a thick capsule. The anterior of the two reaches quite to the fourth ventricle, the ependyma of which is somewhat thickened and marked with small points of blood. The lateral ventricles are moderately enlarged and contain turbid serum. The descending crura of the fornix are soft. Nothing further of interest in the present case was noted in the brain.

The examination of the right petrous bone gave the following results:

The drum-membrane completely destroyed. The cavity of the tympanum is filled with masses of polypi and with greasy pus. The polypi extend into the mastoid antrum through an opening 6 *mm.* in diameter. The mastoid process, which is markedly prominent externally, has a sclerosed wall 15 *mm.* thick. The above-mentioned cavity in the mastoid is situated immediately under the posterior fossa of the skull. The tegmen tympani is pretty thick, and shows slight caries on its lower surface only. Of the ossicles there is no trace; the chorda tympani is also destroyed. On the inner wall of the tympanum the fenestra ovalis is completely open. The facial nerve runs in a curve backwards and downwards along the inner wall of the cavity of the tympanum, in which it lies perfectly free. There it is neither thickened nor congested, whilst from the ganglifform swelling to the internal auditory meatus it is much thickened, and has a reddish-gray discoloration. The Fallopian canal is in its entire course filled with pus, which flows from the internal meatus. The acoustic nerve is intimately united with the facial for the whole length of the inner auditory canal, and presents the same morbid appearances. The vestibule and cochlea contain a moderate amount of pus. The spaces in the diploë of the petrous bone are, especially in the posterior portion, filled with greasy pus.

Remarks.—A continuous line of suppuration can be traced with certainty from the tympanic cavity along the facial nerve into the posterior cranial fossa, and thence below the pia mater to the cerebellum, and the abscess situated in it. Although there was an open road for the passage of pus through the fenestra ovalis (found open on autopsy) into the vestibule, and thence to the internal meatus, the consideration of the varying intensity of the morbid process at these various points makes me incline to the view that the pus followed the track of the facial nerve. It seems to me very probable that there was a predisposition to extension of the disease in this way, due to a very great, if not complete, congenital defect of the bony canal, which surrounds the nerve as it skirts the tympanum, since there were no considerable

gross signs of caries along the course of the facial in the tympanic cavity.

It is especially worthy of note that, contrary to the ordinary view, the muscles of the palate were not paralyzed, although the inflammation of the facial nerve was most marked centripetally from the gangliform swelling.

That the site of the headache is of no account in localizing a supposed brain-abscess, is also shown by this case, in which the pains were always referred to the vertex.

In conclusion, we would remark that several days before death the right tympanum was washed with a warm solution of common salt through the catheter, as a result of which some of the fluid must certainly have found its way through the open road into the inner ear, if not into the cranial cavity; yet no evil results followed either immediately or for some days.

TWO CASES OF SEVERE DISEASE OF THE LABYRINTH, COMPLICATING SCARLATINAL DIPHTHERITIS.

By OSCAR WOLF, Frankfort-on-Main.

Translated by Dr. J. E. Weeks, Resident Assistant-Surgeon to the N. Y. Ophthalmic and Aural Institute.

THE analysis of the following two cases presents some points which have not been clearly described in the existing literature on the subject; in fact there is scarcely an instance of scarlatina-otitis accompanied by severe disease of the labyrinth reported, in which the otitis has been watched from the beginning by an aurist. Before reviewing the present literature on the subject, I will proceed to describe the course of the affection in two cases that have fallen under my observation.

First Case.—*Severe scarlet-fever, complicated with diphtheria of the nasal passages and the post-nasal pharynx. Extension of the diphtheritic process to the middle ear by the Eustachian tubes. Complete loss of hearing.*

Willie Sch., 6½ years of age, previously healthy, came down with scarlet-fever Feb. 1, 1882. Mother died of tuberculosis three years previously. Father healthy.

I was called in consultation with Dr. Heinrich Rehn Feb. 7th, on account of pain of the right ear complained of by the patient. The nasal passages and the post-nasal pharynx had been covered with a diphtheritic membrane for two days, the cervical glands were greatly swollen, and the nose was discharging an offensive purulent fluid. The scarlatinal eruption was still present, the patches were confluent on neck and chest, and dark red like

petechiæ. Fever still high. Pulse 116 to 120. Temperature between 40° and 41° C., accompanied by great prostration and slight somnolence.

Examination of the ears disclosed the following conditions: Walls of the bony part of the external auditory canal of the right ear relaxed, œdematous, and excoriated. The membrana tympani was swollen and softened. Hearing much reduced. $h = \frac{1}{\infty}$. On the left side the hearing (as nearly as could be determined) was slightly below the normal; the left membrana tympani, however, showed no abnormality. Measures were immediately taken to arrest the further progress of the disease. The right *Mt* was freely incised. The incision showed the membrane to be thoroughly softened. After much trouble I succeeded in introducing the smallest size Eustachian catheter through the very narrow nasal passage, and finally, in forcing a little air into the ear, and through the opening in the *Mt*, a small amount of thin secretion was driven out of the tympanic cavity. Liq. ferri sesquichlor. was given internally, and a weak solution was used to syringe out the ear and nasal cavities; a weak solution of carbolic acid was also used to wash the nasal passages and ear, and boracic-acid powder was blown into the external auditory canal.

On the next day (Feb. 8th) the left side was also markedly affected. Examination showed a macerated condition of the *Mt*, closely resembling the appearance of the right *Mt* on the preceding day. Hearing was so much diminished that the patient could not hear the loud voice, in close proximity to the ear. The child was very restless during the night. Fever very high. Morning temperature 41. 2° C. Pulse 130 and very small. Paracentesis of the *Mt* sinistra was performed, and air was forced through the ear by use of the Eustachian catheter. The secretion, which was small in amount, resembled very closely that found in the other ear—thin, serous, inoffensive. On inspection and by use of the probe the tissue of the external auditory canal was found to be soft and spongy, and the mucous membrane of the tympanic cavity was transformed into a spongy, purulent mass. During the first five days the secretion changed from a serous to a purulent character. The general condition of the little patient was very critical from the 9th to the 12th of February. The petechial eruption remained unchanged, swelling of the cervical glands increased, purulent masses were constantly discharged from the nose and pharynx, and food was taken with great difficulty. The body

temperature sank to between 40° and 41° C., with the pulse at 120 to 140. Three days after the beginning of the ear trouble the child was completely deaf; no sound could be heard. Patient complained of sounds in the ear, unaccompanied by pain; these, however, were of a purely subjective character. The treatment consisted of instillations of boracic acid, with weak solutions of liq. fer. sesquichlor. and carbolic acid, used alternately for cleansing the parts. The ear was inflated by the use of the Eustachian catheter, and the passages cleansed with the disinfecting solutions twice daily,—a very troublesome procedure, not without danger to the operator, as masses of membrane were forcibly and frequently ejected. At a later stage the mastoid processes were painted with tr. iodine.

The mucous membrane of the tympanic cavities gradually cleared up and began to throw out granulations. I removed numerous granulations from the left side with my sharp spoon. In the fourth week the discharge ceased almost entirely. When it became possible to obtain a view of the tympanic cavities, I found that the lower half of the right *Mt* was gone; three fourths of the left had also disappeared. The ossicles were present in both ears; the little patient was totally deaf and remained so. In the third week of its sickness, the child appeared to hear the singing of some birds, which gave us some hope of an ultimate partial recovery; these sounds, however, were purely subjective. All conceivable methods for testing the hearing—such as tuning-forks, table-bells, whistles, etc.—were employed, but no perception of sound remained.

After desquamation had set in, the improvement in the general condition of the patient was rapid; in the sixth week the child was permitted to leave the bed. The gait, however, was unsteady, and this, together with a tendency to fall forward, persisted for some weeks. At the end of twelve weeks, these symptoms had disappeared; no defect remained in nose or pharynx.

At the beginning of May, Prof. Moos had the kindness to come to Frankfort, to consult with me in the case. We concluded to try injections of pilocarpin, but could not do so, as the father of the child opposed any further attempts at a cure. The child was now enjoying the benefits of the teaching at a neighboring institute for deaf-mutes, and had fully recovered his speech, which, for two months after his sickness, had been almost wholly lost.

SECOND CASE.—*Severe scarlet-fever, with diphtheria of the post-nasal pharynx. Extension of the diphtheritic process, per tubam, to both tympanic cavities. Recovery of hearing after injections of pilocarpin.*

Cath. B., aged seven years, of healthy parents, was taken sick with a severe form of scarlet-fever, on Dec. 20, 1882. According to the report of Dr. Credener, of Hanau, who was treating the case, severe symptoms rapidly supervened on the commencement of the attack. The eruption speedily became confluent in a number of places, and was dark red in color; pharynx coated with a diphtheritic membrane; cervical glands swollen. The body-temperature ranged between 40° and 41.5° C. for eight days. Prostration great, accompanied with slight somnolence. Salicylic acid was the principal medicine given. The pharynx was pencilled with a disinfecting solution, and old wine was administered to the patient frequently. On the 4th of January I was called to Hochstadt in consultation. At this time the diphtheritis was receding, only a few small plaques were to be seen on the fauces; nasal passages free; strength of patient improving. The child, however, had been totally deaf for eight days. The affection of the ears had proceeded without much pain; annoying subjective sounds only had been complained of. A thin, offensive secretion, small in amount, had been discharging from the ears for three days.

Condition of the ears on Jan. 4th: A thin secretion containing pus and detached shreds of epidermis was present in the external auditory canal of the right side. The lower half of the *Mt* was absent; the handle, denuded of periosteum, appeared free in the opening. The mucous membrane of the tympanic cavity was brownish-red in color, swollen, and covered in places with a yellowish membrane.

The left ear presented nearly the same appearance. However, the loss of membrana tympani was not so great, and the handle was fully covered. The watch could be heard from the temple and in contact with the auricle; tuning-fork large C° from mesocranium doubtful. C′ and A′ could not be heard either from mesocranium or from the external meatus; loud voice could not be heard either. The parents said that the child heard nothing, and that they were compelled to communicate with him by signs.

The air douche could be used in this case without difficulty, both tubes were again freely open, and the air passed through the openings in the membrana tympani of both sides freely.

As the heart action was again strong, and the strength of the patient was thought to be sufficient, I concluded to try injections of pilocarpin.

The treatment was begun by injecting 0.005 gram. under the skin of the neck, twice daily, increasing the dose by 0.001 gram. every two days until the maximum, 0.01 gram., was reached. A few minutes after each injection a half glass of sherry was administered. A solution of boracic acid and a two-per-cent. solution of carbolic acid were used alternately to syringe the ears with, and the mastoid processes were painted with tr. iodine twice daily. The air douche was applied once daily.

The physiological effect of the pilocarpin was complete, profuse sweating and copious salivation followed each injection. I noticed, as early as the third day, that an increased secretion from the tympanic cavities accompanied the profuse sweating and salivation, eventually becoming so copious that it dropped from the ears. I consider this effect of the pilocarpin in this case of great signification. The old school of medicine would, undoubtedly, have regarded this as the "crisis" of the disease. It was fully six days before the first perception of sound was noticed. The fact that perception of the higher tones was the first to return was of physiological importance, as indicating an advanced injury to the labyrinth. On the 14th of Jan. the child complained that the singing of the canary bird in the room with him had wakened him, and although he was formerly very fond of the bird, begged to have it removed. He said that the noise made his ear ache—a hint that we should be very careful in testing the hearing of patients suffering from disease of the labyrinth, and should not permit loud noises to be constantly produced near the ears. On Jan. 15th the patient appeared to understand single words; this seemed to please him very much. The head was apparently freer; he began to play, the appetite increased, and a healthful flush suffused his cheeks. Subjective sounds were now seldom complained of. From Jan. 20th on, a 0.01-gram. injection of pilocarpin was made every two days only. About thirty injections had been made up to this date, and the hearing in the right ear was so much improved that the watch, in contact, could be heard, and conversation at two metres could be under-

stood. At this time subjective sounds were very infrequent. The ability to distinguish sounds in the left ear was still very slight.

Vertigo and trembling were so intense shortly after the commencement of the disease that the child could not hold its head erect without assistance, and had to be supported when taking its food. After six or eight injections of pilocarpin the child could sit erect, but at the time of leaving the bed (seven weeks after the fever began) the child possessed the "duck gait" to a high degree, with an inclination to fall forward and to the left side. The waddling gait did not disappear until the eighth month after the commencement of the disease, remaining four months longer than did the reeling gait in Willie Sch., the first patient. The various subjective sounds also remained much longer in this case than in the first.

From the 30th of Jan. to the 17th of Feb., nine injections of pilocarpin were made; the injections were then discontinued. The tr. of iodine applications had been stopped some time before. The condition of the right tympanic cavity improved much more rapidly than the left. By the 22d of Feb. the discharge had ceased, and cerumen began to be secreted. Insufflations of boracic acid was the last medication employed.

A large number of granulations sprang from the post. wall of the left tympanic cavity, and were removed with the snare at two different times, April 10th and May 28th. On the 21st of July I chloroformed the patient, and removed the carious tissue with my sharp spoon. After this no more granulations appeared. The hearing of the left ear did not come up to that of the right from the first, still, at the beginning of April, loud conversation could be heard at two metres; at the same time, however, whispered conversation could be heard at four metres by the right ear, and the ticking of the watch could be heard at 4 *cm.*

In the fall of '83 his private teaching could be resumed, and the child advanced so rapidly in his studies that he was enabled to attend school early in 1884, at which time he could understand his teacher very easily. On account of the great defect in each *Mt* the hearing was somewhat disturbed, and of course did not reach the normal. In Sept. of '84 the subjective symptoms had disappeared.

Remarks.—In regard to the nature of the disease, there can be no reasonable doubt that in both of these cases we

had to do with a diphtheritic process of the middle ear, plainly communicated, per tubam, from the post-nasal pharynx. In the case of Willie Sch., the mucous membranes of the nose and pharynx were completely covered with the diphtheritic membrane when first examined, the right tube was impermeable, the mucous membrane of the tympanic cavity and the *Mt* dextra blanched and softened. Thirty-six hours later the diphtheritic process had passed through the tube and had invaded the tympanic cavity on the left side. In Cath. B., isolated plaques were still visible in the fauces; a similar coating also covered the mucous membrane of the tympanic cavities in the parts that were visible. As before stated, the diphtheritic process was receding when I first saw the last case, and the disease was not of so severe a nature in this as in the first case.

The anatomo-pathological changes concerned in the production of the deafness in the case of Willie Sch., offer a wide field for discussion. The opinions of Dr. Moos and myself were at variance. Moos believed that the injury to the nerve-endings in the labyrinth was produced by exudation alone, without perforation of the membrana fenestræ, and he based his hope of a good result from the use of pilocarpin on this hypothesis. I was of the opinion, taking into consideration the rapid destructive changes in the tympanic cavities, that the delicate membrana fenestræ had been perforated, permitting an escape of the fluid contents of the labyrinths, and that no improvement was to be hoped for from the use of pilocarpin. The subsequent history of the case favored the latter hypothesis. Complete deafness supervened inside of sixty hours, the subjective sounds disappeared in a few days, and the reeling gait and vertigo disappeared in about two months. In the case of Cath. Br., these persisted at least six months longer.

When we recollect that vertigo, or inco-ordination, is produced by irritation of the nerves of the ampullæ, and disappears on destruction of these nerves, we must conclude that a rapid destruction of these nerves was brought about by escape of the fluid contents of the labyrinth, while in the case of Cath. Br. the membrana fenestræ remained in-

tact, as the diphtheritic process was probably not so severe on the post. wall as in other parts of the tympanic cavity. It is probable that in the last case we had to do with an exudation into the labyrinth, which, for the time, abolished the function of the nerve. This would account for the long duration of the affection, the annoying subjective sounds, and, we may suppose, the improvement brought about by the absorbent effect of pilocarpin. That the labyrinth in the case of Cath. Br. was severely affected, scarcely admits of doubt. Disease of the sound-conducting apparatus alone would not completely abolish the perception of sound through the bones of the skull, as was the condition in this case. C′ and A′ tuning-forks were not heard by bone-conduction, large C° doubtful; the loud voice could not be heard. The return of the hearing, first for high notes (warbling of the canary), argues greatest injury, or embarrassment, to that part of Corti's organ lying next to the fenestra and occupying the first turn of the cochlea.

In regard to the prognosis, these cases show very clearly that if the diphtheritic process has invaded the tympanic cavities, we must be cautious in giving an opinion as to the results. In the case of Willie Sch. the disease involved the sound ear, and in less than thirty hours, in spite of energetic treatment, produced total deafness. In the last case the hearing was, in large part, recovered by the treatment employed, in spite of the fact that total deafness had existed for eight days.

What the peculiar effect of the pilocarpin was is hard to determine. Were the membranæ fenestræ perforated, or was the labyrinth indirectly affected? The appearance of the serous secretion from the tympanic cavities was certainly a very favorable sign. Possibly a decrease in the tension of the labyrinth, and a rapid elimination of the scarlatinal poison, brought about by the great increase in the various secretions, explains the effect produced by the pilocarpin. That we must take into consideration the condition of the heart and the possibility of collapse, in the use of pilocarpin, has been pointed out by the older observers, who have recommended its use in the treatment of diphtheria in

general. Stimulant in the form of good wine is to be recommended, at the time of giving the injection. Pilocarpin should be used in every suitable case, as early as the heart-action and general condition of the patient will permit. In the case of Willie Sch., the danger from the use of calabar bean, in the first two weeks, would have been considerable on account of the great prostration; and later, after extensive destruction of the nerve had taken place, the treatment would have produced little or no improvement.

It remains now to take a short survey of the literature on otitis diphtheritica. Wreden [1] was the first to state that numerous cases of otitis diphtheritica were produced by simple extension of the diphtheritic process from the post-nasal pharynx by way of the Eustachian tube. Wendt,[2] as a result of a number of sections, saw the continuation of the membrane from pharynx along the tube to the tymp. cavity in but one case. Küpper [3] describes a case, as early as 1876, in which he found the tube and the tympanic cavity filled with a croupous exudate. Katz [4] has also reported a similar case. Heidloff [5] goes so far as to state that all cases of otitis media, complicating scarlet-fever, can be referred to the diphtheritic infection.

A. Burckhardt-Merian inclines to the opinion of Heidloff when he says [6]: "We are certain that all those severe and dangerous forms of otitis media, accompanying scarlet-fever, depend on the direct transmission, per tubam, of the croupous or diphtheritic process taking place in the pharynx."

Moos and Steinbrügge [7] are not decided as to whether the disease in the tympanic cavity occurs independently of the process in the pharynx (in the two cases that they observed, during life), or whether the process is communicated to the tympanic cavities by way of the Eustachian tubes, as they failed to secure the cartilaginous portions of the tubes *post mortem*.

Cases in which we find cicatricial tissue in the tubes, following severe scarlatinal otitis, as mentioned in a previous

[1] The numbers refer to the bibliography at the end of the paper.

paper by me,[8] go to prove that the process extends by way of the tubes. On the other hand, I have often observed otitis during scarlet-fever, in which the severe form of the disease was obviated by closure of the tube, occasioned by the inflammatory action in the pharynx.

Gottstein,[9] in his essay: "Beiträge zu den im Verlaufe der acuten Exantheme auftretenden Gehöraffectionen," says that the important question in affections of the ear accompanying the acute exanthems and the infectious diseases, as to whether we have to do with an extending inflammatory process, or whether the ear affection is due, directly, to the specific poison, can only be satisfactorily determined by carefully observing the cases from the beginning; and the opportunity to do this is seldom afforded us. He describes a case where he saw the patient on the fifth day after the commencement of the ear trouble; the hearing, which probably had not been completely abolished, had improved to a certain degree.

The case of Willie Sch. is entitled to careful consideration, as I was fortunate enough to observe the progress of the disease from the very beginning, and for a long time made two examinations daily.

Blau [10] has described a case which, in many particulars, corresponds with the first case reported in this paper. The patient was a child of seven years, in which an otitis media diphtheritica developed on the eighth day of an attack of scarlet-fever. Complete deafness followed eight days after the otitis began,—much slower than in my case. Dr. Blau saw the case, for the first time, fourteen days after the beginning of the otitis, at which time both tympanic cavities were seriously affected. Complete facial paralysis occurred about the twentieth day of the attack; this was probably produced by perforation of the membrana fenestræ, followed by otitis purulenta labyrinthi, and as panotitis, involving the Fallopian canal. Twelve days after the facial paralysis had developed, Wilde's incision was made, the ear cleansed, and relieved of a mass of purulent débris. By this procedure the pressure on the nerve was removed, and the paralysis gradually disappeared; the nerve-endings in the

labyrinth were, however, destroyed. Moos[11] has described the pathological changes present in the labyrinth in a similar case. He found an infiltration of small cells, and a suppurative process of a high degree affecting the membranous saccule, the ampullæ, and the semicircular canals. This process was so far advanced in the cochlea, that the finer elements of Corti's organ could not be distinguished.

An interesting feature in Blau's case was, that twelve days after the disappearance of the diphtheritic process in the post-nasal pharynx and tympanic cavity, it appeared on the auricle, extended into the external auditory canal, and again invaded the tympanic cavity. Blau argues from the above, in opposition to the views of Burckhardt-Merian, that diphtheritic infection of the middle ear may take place by other routes than by simple extension from the pharynx by the Eustachian tubes, The history of my case causes me to favor the views of Heidloff and Burckhardt-Merian; however, I cannot take the stand that diphtheritic infection of the middle ear cannot take place through other channels than by simple extension from the pharynx per tubam. Blau also says: "There is no doubt that many cases of otitis complicating scarlatina are of a diphtheritic nature, and the number recognized will be larger in proportion as we have the opportunity of observing the affection from the beginning."

During the last eighteen years I have myself observed from the beginning (aside from the two cases reported above) many cases of otitis accompanying scarlet-fever, from the simple catarrhal otitis to the most severe forms of diphtheritic panotitis, and have grouped them into three classes.[12] I am of the opinion that the so-called diphtheria of scarlet-fever, as usually employed, indicates, in reality, the severer form of scarlatinal infection only. Paralysis of the pharyngeal muscles seldom or never occurs as a sequela of this so-called diphtheritic process.

It must be admitted that the general condition of the patient influences largely the tendency to complications in scarlet-fever; "lymphatic" children, those who show a tendency to glandular enlargements, and whose parents are

sufferers from chronic diseases, being the ones most easily affected. In such patients the thinness of the walls of the vessels affords but a slight barrier to the passage of the specific poison.

As to the indications for the use of pilocarpin and the manner in which it affects these cases,[13] Moos, at the close of his recent article,[14] seems to coincide with the views adopted by me in the two cases described above, particularly that of Cath. Br. Undoubtedly very beneficial results may be obtained by the judicious use of pilocarpin, when we become acquainted with the precise indications for its exhibition.

As this article goes to press I am observing a case of otitis diphtheritica, which occupies a middle ground between the two cases just reported, and which will be a fitting supplement to this. I shall endeavor to report this last case at a very early day.

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PANOTITIS IN SCARLATINA-DIPHTHERITIS.

By OSCAR WOLF, of Frankfort-on-Main.

Translated by Dr. W. B. Marple, Asst. Surg., N. Y. Ophthalmic and Aural Institute.

IN the following I give the description of an additional case of scarlatinal otitis, which now, after more than five months, can be regarded as accurately enough determined to complete the disease-picture drawn by the two cases described by me in the preceding paper. I have designated the disease in the title as panotitis, inasmuch as the tympanic cavity, mastoid process, and labyrinth must be regarded as simultaneously diseased.

THIRD CASE.—*Scarlatina-diphtheritis with panotitis of both sides.*

Emma v. E., æt. four years, previously healthy, and a blooming, rosy-looking child, but with very delicate, thin skin, and light-blond hair. Was taken sick on Dec. 15, 1884. The mother of the patient had suffered now and then in her childhood from glandular swellings, narrow nasal passages, and subacute otitis; the mother's brother also; during the last four months the child had had frequent attacks of coryza, without, however, showing any impairment of hearing. On the first day of her sickness there was only a slight angina. On the second day distinct scarlatinal eruption. On the fourth day the temperature rose from 39.6° to 40.2° C. (103.3–104.3° F.), and diphtheritic membrane appeared, advancing from the naso-pharynx to the arches of the palate; on the sixth day considerable impairment of hearing (the first symptom of ear disease). On the seventh day I saw the patient for the first time in consultation with my colleague, Heinrich Rehn. The child had been very restless during the night, chiefly

on account of high fever (39.6–40.3° C.), which was not influenced particularly by three one-gramme doses of antipyrin. The little patient lay indifferent with mouth wide open and gave no answer to the questions asked her. It could not be determined whether the ability to perceive speech was still present or not. In both auditory canals were cast-off shreds of epidermis, and a little thin, discolored, fetid secretion. Both tympanic cavities were filled with whitish-yellow, partially organized masses of diphtheritic exudation ; drum membranes completely destroyed. When the nose was syringed out (with solutions of carbolic and boracic acids) yellowish-white masses of membrane, tightly rolled up, were evacuated from the naso-pharyngeal cavity. Politzer's method was employed, and the stream of air whistled through the holes on both sides. After this some improvement appeared, and in the afternoon the head was freer ; the child had spoken some sentences. Pulse 120, evening temperature 40.1° C. The eruption still continues, but shows only the usual scarlet redness and is not petechial in character. Maxillary glands moderately swollen ; urine not very copious, but free from albumen. Patient drinks a great deal, but takes absolutely no nourishment. Ordered liq. ferri sesquichlorat. internally.

Dec. 22d.—Patient was very restless during the night. Anasarca of both eyelids, of the hands and feet. Urine light-colored, copious, and without albumen. On syringing out the ears partially organized, diphtheritic masses were again removed. Over the left mastoid process was a painful swelling. Patient still appears to understand loud speech, and heard a dog bark in the yard. Morning temperature 39.6° C. ; evening, 40.3° C. Pulse 130.

Dec. 23d.—As an experiment 0.005 gm. of pilocarpin muriate was injected under the skin of the neck. Two hours afterward there was moderate perspiration, with great restlessness and oppression.

Dec. 24th.—The injection of pilocarpin cannot be continued on account of the weak condition of the little patient. A deep Wilde's incision had to be made over left mastoid process, by which about two teaspoonfuls of fetid *bone*-pus was evacuated. Drainage. Also from both auditory meatuses I removed with my sharp spoon fatty-degenerated granulation masses. On the left side, on the posterior wall of the tympanic cavity and auditory meatus, appeared an extensive spot of denuded bone. The gen-

eral condition in the evening was somewhat better. Vertigo is not so marked, for the child can now sit up straight alone. Acuteness of hearing uncertain. Pulse 120. Temperature 39.2-39.8°C.

Dec. 26th.—Yesterday evening there was again high fever. Patient very restless during the night. On the left side there was erysipelas, reaching from the region just back of the ear to the middle of the cheek. Very fetid pus discharged from the wound of incision. Yet for the first time I succeeded in washing it out thoroughly, so that the boracic-acid solution injected into the tympanic cavity with a pretty forcible stream flowed out from the incision wound. The probe disclosed the fact that the bone was extensively denuded of periosteum.

Dec. 28th.—Naso-pharynx freer ; only a little diphtheritic membrane removed. Swelling of face beginning to diminish ; erysipelas subsiding ; the latter was probably caused by retention of fetid pus in mastoid process. Morning temperature, 38.5°C. ; evening, 38.6°C. Pulse 100. Some appetite.

Dec. 29th.—Anasarca no longer present. Urine abundant, without albumen. Inspection of the ears reveals the following :

Right : mucous membrane of tympanic cavity dark red ; three fourths of drum membrane destroyed ; the handle of the hammer entirely denuded of periosteum, light-yellow in color, projects freely into the opening ; process of incus not visible.

Left : mucous membrane of tympanic cavity dark red, but less loosened ; somewhat smoother than the right. Almost all of the membrana tympani is gone ; the manubrium mallei, denuded of periosteum, projects freely into the opening, as also the long process of the incus which appears to stand remarkably straight. Perhaps a loosening of the stapes, and with it of the movement of the chain of ossicles has taken place.[1] The child now speaks distinctly, and also swallows more easily since the swelling of the pharyngeal mucous membrane has also subsided.

Dec. 30th.—The erysipelas has disappeared : the incision in the mastoid looks healthier. In syringing, the water circulates freely through the mastoid antrum, and flows out through the incision ; secretion less fetid.

[1] This supposition is further supported by the marked retraction of the handle of the hammer, established at the close of this observation. In consequence of the cicatricial contraction, especially marked in the posterior section of the tympanic cavity (formerly profuse granulations sprang from this vicinity) the long process of the incus, loosened from its connection with the stapes, could rise somewhat, together with the malleus, and deviate upwards and backwards.

Dec. 31*st.*—Evening temperature 39.2°C; somewhat elevated again on account of a recent gastric disturbance. Patient is unsteady, showing, when seated, a tendency to fall towards the right side. Weakness and loss of appetite still very considerable. The acuteness of hearing cannot be determined since the child does not give direct answers at all. On account of the weakness of the little patient the use of pilocarpin had to be discontinued.

Jan. 3*d*, 1885.—General condition better. No vertigo when sitting up.

Jan. 8*th.*—Restless during the night on account of pain in right ear. Periostitis of right mastoid process is beginning.

Jan. 10*th.*—Right: Wilde's incision, and evacuation of almost a teaspoonful of fetid *bone*-pus; irrigation through the antrum now succeeds as formerly on the left side.

Jan. 13*th.*—Submaxillary glands of left side again much swollen. Ordered ungt. pot. iodid.

Jan. 14*th.*—Appetite good. Appearance of incision also good. Child is lively. Voice smooth and melodious, as formerly; the little one, in relating a story, changes the modulations of the voice, according as to whether she personates, in talking, a man or child. I endeavored now, above all, to determine the acuteness of hearing, in order to discover the condition of the sound-perceiving apparatus. The further therapy, of course, had to be made dependent upon the result of this examination; I had to determine especially whether the use of pilocarpin, formerly stopped, should be resumed, now that the strength of the patient had so much increased. But the examination of the acuteness of hearing offered unusual difficulty in this case. This difficulty consisted, on the one hand, in the previous education of the child, who, as the teacher said, had hardly ever given direct answers, even during perfect health. She always had spoken of herself in the third person, as, for example, "somebody hears," instead of "I hear." On the other hand, on account of fear, she invariably gave me affirmative answers to all my questions, inasmuch as she had, naturally enough, become very much afraid of me on account of my various therapeutical measures. If I asked her a question, the little patient always nodded her head in the affirmative. I requested the mother and teacher, therefore, to write down all words which she should subsequently speak. After some days, I had the pleasure of being able to determine the following: High consonants, especially the sound "S," were heard; "*nass*,"

"*wasser*," were afterward pronounced. The light, weak sound of "F," on the other hand, was in no case perceived. Instead of "*Fuchs*" was heard "*Uchs*," and consequently the little patient could not be made to understand what animal in the picture-book was meant. Also the word "*Kœnig*," especially the sound of "K," she did not appear to hear.

Jan. 15th.—The child, of her own accord and for the first time, says: "My ear rings." From now on the subjective tone-perceptions appear stronger; she asks, for example, "whether papa has been playing the 'cello'"; also says: "It sounds in my ear like a railroad."

Jan. 23d.—Secretion less copious on both sides, and more tenacious. Granulations are springing from the wall of the right tympanic cavity. Nevertheless, with Politzer's method, the air still streams freely through. Left: The denuded manubrium seems to be getting covered with a profuse crop of granulations; also the process of the incus.

Jan. 25th.—First attempt to walk. The child says: "I am dizzy."

Jan. 26th.—Second attempt to walk; she staggers in a marked manner after a few steps.

Jan. 28th.—After repeated attempts to walk (the first and second attempts did not allow of an exact examination) there is noticed a distinct tendency to fall to the right. The subjective perceptions of tone (music, conversation) are now quite intense, especially about noon, after drinking a little old wine, which she uses as a tonic. The general condition is much improved; the child is very lively, and sings various songs.

Feb. 4th.—The words "*Bor*" and "*Rhabarber*," which the child formerly did not know, are now spoken by her. Various other questions, however, are not correctly understood. On applying the large C^0 fork to the cranium[1] the patient says, "one hears music"; with A^1 fork, "it ticks"; while the sound of a high pipe C^5 is plainly unpleasant to her. The child was now put before the piano. She touches the different keys with pleasure: with the deep tones she says, "one hears music"; in the middle register, "one hears nothing"; while she again hears the high notes.

Inasmuch as it seemed probable from all the symptoms which have been described, that there was still present considerable dis-

[1] The examination of the hearing with tuning-forks very seldom gives a positive result in young children.

turbance in the sound-perceiving apparatus, it was decided to resume the use of pilocarpin, formerly suspended. Nevertheless the parents wished beforehand the advice of Prof. Moos, who was called in consultation Feb. 6th. We were essentially of the same opinion, and decided to continue the pilocarpin injections.

Feb. 6th.—Fistulous opening over the mastoid process. Right closed. Patient complains very much of subjective noises. "It goes clap ! clap ! in my ears." As it was impossible, for other reasons, for the parents to remain here in the hotel any longer, the family moved to Heidelberg, and Prof. Moos took charge of the further treatment, especially of the administration of pilocarpin treatment.

April 6th—I saw once more the little patient in company with Prof. Moos, in Heidelberg, while passing through there. The membrane lining the tympanic cavity was less swollen, partially cicatricial in character. The manubrium and process of incus, in both ears, seemed to be again covered. The understanding of speech considerably increased; she repeated a number of words distinctly; she did not hear the weak "F" sound at all, for example she called me "Doctor Wol," while she had nevertheless never heard my name correctly, since I had never spoken to her previous to her becoming deaf from scarlet-fever. Also distant noises and rumbling on the street were heard. At this time, about 26 pilocarpin injections had been made, and they were still continued, twice a week, and were well borne. The child was fresh, lively, looked healthy, and was very talkative.

Remarks.—In the introduction to this case I said that, standing in a certain sense in the middle, it formed a supplement to the two formerly described cases. The form which Willie Sch. (Case 1) had presented had been the most injurious in its results; after little more than forty-eight hours there was total deafness, early loss of subjective perception of sound, early alteration of the sound of his own speech; after three months no more uncertainty of gait, although the visible changes in the auditory apparatus were not of so high a degree as in E. v. E. (Case 3), in whom a speedy destruction of membrana tympani and of periosteum in various places, especially of the chain of ossicles, and of both mastoid processes could be demonstrated at the beginning of the eighth week of the disease. The voice of this

child was unchanged in its melody; the acuteness of hearing for a number of tones doubtful; the subjective perception of sound still intense; locomotion, without a guide, still impossible on account of attacks of vertigo. It can be well supposed, therefore, that the membrane of the fenestra, was still intact in the child, but that at the same time disturbances in the function of the nerve apparatus existed, which could gradually disappear.

In Catharine Br. (Case 2), the labyrinth was in the beginning in a similar condition, but, as the diphtheritic process began to subside much sooner, and the labyrinth was speedily relieved, the one half of the drum-head remained, and the mastoid processes were not involved; the improvement in the hearing accordingly followed sooner and to a more considerable degree, beginning with the reappearance of subjective perceptions of tones.

The PROGNOSIS in such cases will always be extraordinarily difficult, so much the more perplexing for the physician, as the anxious parents ask almost daily, and wish to have encouragement. It seems to me that the question is very essential, whether a loosening of the articulation of the stapes and incus has taken place in consequence of the latter being denuded of its periosteum. In E. v. E. this seemed to me not improbable, at least in regard to the left ear. If with every sound the stapes makes an unlimited pendulum movement and oscillation, there must arise from this an exceedingly inexact perception of sounds on the one hand,[1] while on the other hand, it is conceivable that in the beginning attacks of vertigo can be excited during walking, on account of the calling forth of greater movements of the stapes, which can be by degrees eventually overcome by habit, and also by the formation of scar-tissue, and the new fixation of the stapes. The vertigo in such cases, therefore, need not be always referred to a disease of the labyrinth.

So far as the therapeutics are concerned, all those cases show us that the means known to us are not able to oppose the

[1] Compare the determination of sound perception in loss of malleus and incus in the author's "Sprache und Ohr," pp. 150–165.

injurious operation of the diphtheritic exudation, even in the first few hours of the ear trouble. Masses of partially organized exudation appeared in the tympanic cavity, and that, too, in the most delicate parts ; if we had now instilled a 10-per-cent. alcoholic solution of salicylic acid, it would have remained for the most part on the upper surface of the exudation without availing any thing, even if it had really reached the tympanic cavity, while on the other hand, if it had reached a vulnerable spot, it could have caused even a rupture of the fenestra membrane. We must, in my opinion, in such cases, refrain from attempts to influence the diphtheritic process itself, and be satisfied with emptying as quickly and completely as possible the tympanic cavity of exudation, and ought only to resort to disinfecting means that do not corrode.

By the use of pilocarpin injections in the first place we are enabled to loosen more easily and effectually the diphtheritic exudation, and at the same time the labyrinth is speedily relieved, especially by the marked increase of the secretion of the mucous membrane of the tympanic cavity. But this treatment is very much interfered with, and that, too, at the height of the disease, by the somnolence and tendency to cardiac weakness induced by it, with no inconsiderable danger to the life of the patient; one should, therefore, begin very cautiously, with very small doses of this medicine, and only after careful examination of the general condition.

Supplement.

By Dr. S. Moos.

Under the application of alcohol, healing by formation of scar-tissue (very delicate connective-tissue scars) had already taken place on the right side by the end of April, and an adhesion of the handle of the hammer (very much thinned in its middle third) with the promontory. In the middle of May there still persisted on the left side a scanty secretion from the red and still thickened mucous membrane of the labyrinth wall; the handle of the hammer was

also on this side drawn towards the promontory, and only posteriorly could a beginning cicatrization of the opening in the membrana tympani be detected.

Forty-one pilocarpin injections were made altogether, from Feb'y 8th to May 1st. The first twenty-five were of a one-per-cent. solution, the last sixteen of a two-per-cent. solution. The strengthening of the solution was necessitated, because the desired diaphoresis diminished as the strength of the patient increased. At the end of March the little patient showed an increase of body-weight of almost one kilo. (2 pounds), notwithstanding frequent and excessive perspirations. In the beginning I made the injections daily, then every other day, then twice a week. The medicine was laid aside entirely only when vomiting commenced to appear regularly after the injections, which was the case in the last six. I could the sooner dispense with the medicine now, inasmuch as the walk of the patient began to be much surer, her fund of words increased, the most diverse musical tones were well distinguished; and before the completion of the treatment, the little patient declared, without being asked about it, that she heard a strong-ticking watch (10 metres hearing distance) louder between the teeth, and against the head, than she had formerly heard it in the ear.

EXAMINATIONS OF THE AUDITORY ORGAN OF SCHOOL-CHILDREN.

By Dr. FRIEDRICH BEZOLD, Munich.

Translated by Isidor Furst, New York.

(*With four plates of curves and three wood-cuts.*)

As in other departments of medicine, so in otology the need is felt ever more urgently to study the forms of disease not only in their anatomical and physiological relations and their etiology, but also to learn their frequency and prevalence among the total population.

There is no lack of statistical reports on the number of ear patients coming under treatment; and Bürkner,[1] in a collective synopsis of the statistics of ear diseases, recently published, was able to enumerate twenty-five authors who have given us, partly in a series of annual reports, statistical communications about the relative frequency of the ear diseases which had come under observation. I myself have made five reports, each of them comprising three years, about all the ear patients, 7,537 in number, which I have seen in a practice of fifteen years.[2]

Such reports may furnish information as to the relative frequency of the various forms of disease, their prevalence at different ages, in the two sexes, the influence of occupation, seasons, etc.; we may learn from them also that ear diseases must be of frequent occurrence, but they give

[1] Beiträge zur Statistik der Ohrenkrankheiten.—*Arch. f. Ohrenheilk.*, Bd. xx., p. 82.

[2] *Aerztliches Intelligenzblatt*, 1872, Nos. 40 *et seq.*; 1875, Nos. 26 *et seq.*; 1878, Nos. 44 *et seq.*; 1881, Nos. 26 *et seq.*; 1884, Nos. 49 *et seq.*; and *Arch. f. Ohrenheilk.*, Bd. xxi., p. 221.

us no answer to the question which is to be placed at the head of all others: How great is the prevalence of ear diseases in the total population? What is their *absolute* relation of frequency? The approximate estimate by v. Tröltsch, expressed by him in his text-book as early as twenty years ago or more, that in middle life, between twenty and fifty, at least *one* among every three men can no longer hear well and normally in *one* ear, corresponds nearly with the experience of all otologists. However, this is only an approximation, and it was of interest, not only to physicians, but generally, theoretically, and practically, to make it statistically certain by examinations of large numbers.

A numerical statement as to the occurrence of defective hearing among recruits is given by Trautmann,[1] who found 2.02 per cent. of defective hearing among 2,327 men. This number, however, is much too small, because Trautmann, owing to the rapidity with which the work must be done, could examine only those who reported somewhat deaf on inquiry.

As may be seen from the reports of all otologists, even childhood furnishes quite an important contingent of ear patients, and Bürkner, in the above-mentioned collation of reports, found that children up to the fifteenth year of life constituted a percentage of 22.2 of the grand total. In my last triennial report, just issued, I count among 3,846 ear patients 20.5 per cent. children to the fifteenth year.

Experience having taught me that a large number of ear diseases found in adults may be traced back to affections recovered from in childhood, I felt impelled to reiterate in every one of my reports how important therapeutical measures are, especially at that age; and the question had long ago occurred to me how large might be the absolute relative frequency of diseases of the ear in childhood.

The first examination of school-children was made by W. von Reichard[2] at Riga; it comprised 1,055 children between

[1] Ueber den Werth der Ohrenheilkunde für die Militärärzte.—*Arch. f. Ohrenheilk.*, Bd. vii., p. 103.

[2] Ueber die Bedeutung eines guten Gehöres für die Schulbildung, W. v. Reichard, Arzt des Städtischen Gymnasiums zu Riga.—*Petersburger med. Wochenschr.*, No. 29, 1878.

seven and fifteen years. Unfortunately he tested the hearing power with the watch only. There were 22.3 per cent. who could hear only at 20–0 feet a watch which was heard by others at 20–60 feet and beyond; the defect was nearly uniformly divided among the sexes. About the diseases to which the defective hearing is due there are no statements contained in the paper, which enumerates chiefly lack of cleanliness and exposure to cold, aside from diseases of childhood, as the reputed causes of their frequency.

For more comprehensive and thorough examinations of the hearing of school-children we are indebted to Dr. Weil,[1] of Stuttgart, who tested 5,905 children for their hearing distance by means of whispered speech, and also determined the diseases present, by otoscopical examination. In some schools there were more than thirty per cent. who could not hear whispered speech at 8 metres, the hearing distance of which for the normal ear is 20–25 metres.

Besides, there are on record two smaller series of examinations by American otologists, Samuel Sexton[2] and Morrell,[3] the former of whom tested 570 school-children, among whom were 261 colored children; the examination, it is stated, could be performed superficially only, and showed 76 cases, or 13 per cent., of greatly impaired hearing power. The latter reports on 491 children, of whom 72 showed bilateral and 53 unilateral, together 25 per cent., diminished acuteness of hearing.

Little as these results can be directly compared with each other, partly because they were made with varying acoumeters, partly because different demands were made of the normal hearing distance, still they all prove that defective hearing in childhood is sufficiently prevalent to deserve our full attention.

It cannot be the task of any one person to collect sufficiently large statistical material for the solution of this question, and even my examinations, which I have continued with school-children for more than a year, comprise

[1] Die Resultate der Untersuchung der Ohren und des Gehöres von 5,905 Schulkindern.—*Zeitschr. f. Ohrenheilk.*, Bd. xi., p. 106.

[2] *Zeitschr. f. Ohrenheilk.*, Bd. xi., p. 333, and Bd. xii., p. 215. Review.

[3] *Zeitschr. f. Ohrenheilk.*, Bd. xiii., p. 236. Review.

only the proportionately small number of 1,918 children. If carefully executed, they require pretty much time, and I have laid greater stress on perfecting a uniform method, which might perhaps serve other investigators, than on very large numbers.

My examinations comprise three schools at Munich, viz., the alumni of the Ludwigsgymnasium, the so-called Holland's Institute; and two public schools, the former Common School II. A, and the Protestant School II. I am indebted to the principals of those institutions, not only for the permission to make the examinations, but also for their kind assistance.

In my first tests, made in Holland's Institute, I set myself the preliminary task to compare with each other our most generally used acoumeters — watch, Politzer's uniform acoumeter, and whispered speech—as to their applicability for examining large numbers, as has been done by Hartmann.[1] As I had at my disposal here intelligent young people, Latin scholars and college boys of from 10–18 years, I could expect more reliable statements than, for instance, in the lower classes of the public schools.

I chose for my examination an oblong dormitory facing the yard; because, containing a large number of beds and other furniture, it showed no material resonance of the walls, such as enters as a disturbing factor for tests of hearing in larger empty rooms. The dormitory was 15 metres long or, including the recesses of the doors, 16 metres, and 8 metres broad. In order to increase the distance, I utilized a dormitory adjoining the narrow wall and connected by a door, the frame of which, of course, deflected a part of the sound-waves. Owing to this fact, the upper limit of the hearing distance is rather too small, especially for whispered speech and probably also for Politzer's acoumeter, as will appear by comparison of the hearing distance for my whispered speech in the drilling rooms of the public school. As the examinations were usually made in the evening after four o'clock, when the other pupils were busy at their tasks, and the noises from without could not enter the room,

[1] *Arch. f. Augen- und Ohrenheilk.*, Bd. vi., 2.

which was remote from the street, the quiet was as perfect as can be obtained during the day.

While testing the hearing for whispered speech and Politzer's acoumeter, the persons to be examined stood at one of the narrow walls of the dormitory, turning the ear to be tested toward me, the other being tightly closed with the finger; I moved along a line on the floor marked in metres, which extended through the door into the adjoining room. In the drilling rooms where I examined the other schools, I used the diagonal line, partly to increase the distance, partly to deaden the resonance of the walls.

During tests with the watch, both of us stood on the same line in the middle of the hall, and the person under examination had his eyes covered with a shade, so that I could convince myself, by holding my hand before the watch or covering the watch with it, to what extent the statements as to the hearing distance rested on self-deception, which was not rare, as I ascertained in this manner. It is necessary, too, that the person under examination lays aside his own watch.

Politzer's acoumeter, as a rule, was at a sufficient distance to make it unnecessary to cover the eyes; the pupils were obliged to state the number of beats made each time.

The words employed in testing with whispered speech were exclusively the numbers from 1–99. They furnish sufficient variety to permit the formation of an opinion respecting the power of understanding speech generally. I also have convinced myself, especially during these examinations of large numbers, that we should by no means expect, in continuing to employ the same words, successively easier guessing. On the contrary, this fault, all the children knowing that they are tested for numbers, applies equally to all those examined, and hence can be disregarded. At all events, in using whole sentences, much more is liable to be guessed than with single words. Besides, it is found that certain words or numbers are not gradually guessed more easily on continuing the examination, but always some of their consonants are misunder-

stood or not heard at all by all the persons examined, until we have reached the limit of perception of the individual. It was these latter numbers which served mainly as the measure for ascertaining the limit of audition. Besides the number 100, which in proportion to all the other numbers is heard at too small a distance, it was the numbers 7, 5, 9 which were understood with the greatest difficulty both at the beginning and at the end of double numbers, and therefore always had to be interposed again between the other numbers. 5 (in German "fünf") and 7 are always mistaken for each other or for 6 until we are at the limit of audition; 5 as a rule is heard at a smaller distance than 7. Still smaller generally is the hearing distance for "neun" (nine); instead of it "ein" (in German pronounced "īne") is constantly heard by all until we reach the limit of perception. Only at the distance where "neun" at the beginning of a double number, as well as all the other numbers except "hundert" (hundred), were correctly repeated after several tests, I placed the limit for hearing whispered speech. The results were finally verified by the number "hundred"; where this is heard we can be certain that the distance is rather too small than too great; the understanding of this number can be no criterion, because, contrary to the others, it is comparatively easily guessed, as it alone contains the vowel *u*.

With the smaller children of from 6–7 years in the public schools I was forced to continue these tests for a pretty long time, until I obtained uniform results with the individuals. The children had to become used to the hearing of my organ, and partly also get more familiar with the double numbers. In testing with whispered speech I have taken special care and spared no time, because on its results are based all the examinations here following.

The results of the tests of 222 auditory organs examined in Holland's Institute according to the three methods, whispered speech, Politzer's acoumeter, and watch, are recorded in Table I. (p. 165).

They are, moreover, represented graphically in plate 1 (of vol. xv., Ger. ed.). The abscissas of this figure represent the

hearing distance expressed in metres; and the height of the ordinates means the number of those hearing at the distance above given. The continuous line is the curve for whispered speech; the broken line, for Politzer's acoumeter; and the dotted line for the watch. If we consider first these curves, it appears by comparing them that the maximum for the normal hearing distance of whispered speech is much higher and more definite in form than that for Politzer's acoumeter, and still more so than that for the watch. The elevation of those having the best hearing for whispered speech rises to an ordinate of 67, and shows a more pointed form than that for Politzer's acoumeter, which rises only to an ordinate of 45; the decline is nearly uniform for both. The curve for the watch even shows two maxima separated by a hearing distance of two full metres, both of which rise only to the number 27; the rising as well as the falling of the curve is much more gradual. This relation of the three curves to each other we can interpret only to this effect, that the total results furnished by the examination with the watch are very much less definite than those obtained with Politzer's acoumeter; but that the latter, too, is greatly exceeded in definiteness by whispered speech. We shall hardly err if we consider the result of this examination of large numbers as in the main applying to the individual.

An unavoidable error has arisen in the curves for whispered speech and Politzer's acoumeter by the fact that in Holland's Institute I had at my disposal a hall only fifteen metres in length; while the hearing distance for the former, according to the results obtained by Wolf, Chimani, Hartmann, and others, is twenty to twenty-five metres; and that for Politzer's acoumeter, according to Hartmann, fifteen metres, and still more according to Weil. As I, too, ascertained by these examinations, a distance of twenty metres is still too small to determine the upper limit both for whispered speech and for Politzer's acoumeter. The measurements for the watch are not affected by this error. However, that the former two curves, despite this error and the relatively small number of auditory organs examined in Holland's Institute, still give an approximately correct picture of the relation of

TABLE I.

HOLLAND'S INSTITUTE.

Hearing Distance of the Single Auditory Organs for Whispered Speech, Politzer's Acoumeter, and Watch.

Whispered speech is heard at metres .					18	17	16	15	14	13	12	11	10	9		8		7		6		5		4		3		2		1	0.80	0.50		0.10			
By					13	20	67	26	16	15	20	4	9	2		4		6		2		2		1		5		3		2	2	1		2			222
Politzer's acoumeter is heard at metres	22	21	20	19	18	17	16	15	14	13	12	11	10	9		8		7		6		5	4½	4	3½	3	2½	2	1½	1		0.50	0.25		0.01		
By	1	1	3	7	16	45	43	31	6	6	13	7	5	1		6		5		2		2	1	1	1	1	2	7	2				3		1		222
Watch is heard at metres														9	8.5	8	7.5	7	6.5	6	5.5	5	4.5	4	3.5	3	2.5	2	1.5	1	1.75	0.50	0.25	0.12	0.06	0	
By														1		2			3	4	8	20	27	15	20	17	27	22	19	9	11	6	1	6	3	1	222

TABLE II.

HOLLAND'S INSTITUTE.

Relation of the Hearing Distance for Whispered Speech to that for Politzer's Acoumeter and Watch.

Number of persons hearing at distances stated		13	20	67	26	16	15	20	4	9	2	4	6	2	2	1	5	3	2	2	1	2	Total.
Hearing distance for whispered speech in metres		18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0.80	0.50	0.10	Metre.
Politzer's acoumeter is heard by the above	average.	17.4	17.1	15.8	14.6	14.5	14.1	12.9	12	10.6	9.8	10.5	7.9	2.2	3.8	2	2.2	0.7	1.5	5	0.45	0.11	"
	maximum	21	22	20	19	18	18.5	17	15	16.5	10	15	17	2.5	4		5	1.5	2.5	8		0.2	"
	minimum	13	15	7	6.5	10	9.5	5.5	10	2	9.5	8	3	2	3.5		0.5	0.25	0.6	2		0.01	"
The watch is heard by the above	average.	415.2	469.5	364.7	311.2	296.6	274.7	222.5	202.5	238.9	175	146.2	149	72.5	60	65	30.2	16	12.5	26	15	0.25	Cm.
	maximum	800	900	650	550	500	450	350	325	550	175	300	350	75	70		75	35	15	42		0.5	"
	minimum	150	200	60	100	110	100	100	200	50	175	80	60	70	50		10	6	10	10		0	"

the hearing distance of children, appears by comparing them with the other curves for whispered speech which I have obtained as the expression of the hearing distance of all the children examined, and which have resulted very similarly, only more definitely than the curve here found, corresponding to the larger number of children. If we inspect the curve there obtained and which is divided according to equal quota of the hearing distance, we shall see why the error for the first two curves of plate 1, which is due to the insufficient size of the place of examination, does not materially affect the result.

In Table II. (p. 165) is recorded the relation of the hearing distance for whispered speech to that for the other two acoumeters, which I have obtained for the single auditory organs perceiving whispered speech each at a certain distance; namely, first, the average hearing distance for the watch and Politzer's acoumeter, which coincides with the respective hearing distance for whispered speech, and second, its maximum and minimum.

This table shows that a large number perceiving speech at an equal distance hear not only the watch—a well-known fact—but also Politzer's acoumeter at greatly varying distances. Thus, for instance, of 67 auditory organs which understood whispered speech at 16 metres, the watch was heard on the average at 364.7 *cm.*, maximum 650, minimum at 60 *cm.* Such great differences, of course, are not obtained with Politzer's acoumeter, at least with normal or approximately normal hearing. Only among the 5 pupils who perceived whispered speech at 3 metres is there a similar great difference between maximum and minimum as there is in the above example for the watch—that is, an average of 2.2, a maximum of 5, and a minimum of 0.5 metres. Among those hearing speech as far as 11 metres, the maximum and minimum for Politzer's acoumeter varies, with an equal hearing distance for speech, about in the proportion of maximum 3, and minimum 1; for the watch, however, between maximum 10 and minimum 1. It is noteworthy, besides, that those who heard the watch out of proportion badly, showed on an average a similar disproportion also for Politzer's acoumeter as compared with speech.

The comparative graphic representation of the hearing distances for the three acoumeters has yielded another advantage which is very essential to the appreciation of my total investigations. It gives us a generally useful measure for the sound intensity of my whispered speech. One glance at fig. 1 shows that the two curves for whispered speech and Politzer's acoumeter very nearly coincide in their course; that therefore my whispered speech is heard almost at the same distance as the Politzer acoumeter obtained from the optician Gottlieb, of Vienna, and which serves as a uniform measure. In this way the intensity of my whispered speech is determined, and every succeeding examiner in schools can in the same way determine, on a number of pupils, the relation of the hearing distance for his whispered speech to Politzer's acoumeter before entering on the proper examination of large numbers. In this way we shall also get absolutely comparable values for hearing tests with whispered speech. Lucae's[1] maximal phonometer, which is likewise intended to give a measure of intensity for speech, was not applicable for me, because the instrument purchased by me measures only the pressure of expiration employed for explosive consonant sounds, and shows but a minimal motion, or none at all, in words containing no explosive sounds, as particularly for the words "fünf, sieben, neun," which, as above stated, had to serve in our determinations as the numbers audible at the smallest distances.

Since O. Wolf[2] has found and determined the tones contained not only in the several vowels, but also in the consonants, and the relative proportional intensity of speech-sounds to each other, speech as a test for the hearing has become much more accessible to our judgment, and I believe with Wolf that, at least for the examination of large numbers, we shall look in vain for a better acoumeter which extends over an equal length of the scale and at the same time gives us information as to the perceiving capacity for the most variable noises, which it is absolutely impossible to do without, in a complete examination of the hearing.

[1] *Arch. f. Ohrenheilk.*, Bd. vi., pp. 276 and 294.

[2] "Sprache und Ohr," Brunswick, 1871.

Some tone defects, of course, may escape us during the exclusive employment of whispered speech in testing the acuteness of hearing, and it would be a desirable addition if, besides, a complete tone scale, especially the upper part not contained in speech, were used in the test. Such completeness, however, is out of the question in school examinations which must not consume too much time. Besides, the number of ear patients in whom tone defects are demonstrable seems to be but small. Burkhardt-Merian, who has made extensive examinations in this direction and has reported thereon at the third International Otological Congress in Basle, kindly informs me on inquiry that among more than 700 tests in ear patients he was able to determine tone defects in 7 cases only—that is, less than one per cent. of the ear diseases.

In order to attain always an approximately equal intensity of my whispered speech, I have followed a very simple rule : In speaking I have used only the residual air remaining in the lung after an expiration which is not forced. According to my experience, this precaution suffices to render the whispered speech of the individual sufficiently uniform for testing the hearing. I have also endeavored, like Weil, to speak always in the same tempo.

In the two public schools I was able to use somewhat larger localities for the examinations, viz.: in the Common School II. A, the drilling-room having a diagonal of eighteen metres, and in the Protestant School II. likewise the drilling-room having a diagonal of twenty metres. In these rooms, too, the resonance from the walls, etc., was much reduced by the numerous utensils present. But few extraneous noises from without entered into these localities. The greatest disturbance I met with in the drilling-room of the common school, which is surrounded by gardens, was in the shape of the twittering of the birds, as the examination was made in the spring and summer. In the same place I became aware of another possible source of error. On a sunny day, when through the numerous windows a row of sunbeams fell across my field of examination, the results of the tests appeared to me remarkably poor, and this might perhaps be explained by

TABLE III.

Combination of the Three Schools Examined.

Hearing Distance for Whispered Speech of the Single Auditory Organs in Metres.

Age.		20 Mt.	19 Mt.	18 Mt.	17 Mt.	16 Mt.	15 Mt.	14 Mt.	13 Mt.	12 Mt.	11 Mt.	10 Mt.	9 Mt.	8 Mt.	7 Mt.	6 Mt.	5 Mt.	4 Mt.	3 Mt.	2 Mt.	1 Mt.	0 Mt.	Total.
7 years .	Boys.	20	9	94	44	28	15	14	13	10	13	8	12	17	8	7	15	9	5	12	13		366
	Girls.	24	19	112	46	25	25	15	10	11	15	10	13	15	11	10	5	7	11	9	6	1	400
8 " .	Boys.	15	9	110	44	26	28	9	13	12	9	4	8	16	8	6	13	4	7	5	14		360
	Girls.	21	22	84	56	32	26	18	20	9	9	18	12	16	13	19	11	7	9	3	9		414
9 " .	Boys.	23	16	88	57	22	24	12	14	12	7	3	12	20	8	5	5	5	1	7	6	1	348
	Girls.	18	12	35	34	23	18	12	11	9	7	5	12	9	13	12	14	10	4	1	9		268
10 " .	Boys.	25	11	108	48	21	26	24	16	16	8	7	7	22	6	4	9	8	4	7	11		388
	Girls.	17	9	61	35	21	23	10	20	10	14	8	10	10	16	11	9	12	4	5	9	2	316
11 " .	Boys.	18	15	7	6	9	1	6	4	10	3	5	1	4	5	5		3	5	1	1	1	110
	Girls.	14	6	30	17	17	8	7	9	10	6	7	4	6	6	9	2	2	8	4	2		174
12 " .	Boys.	24	7	3	2	3	3	8	8	5	2	1	2	4	5	1	4		3	1	2		88
	Girls.	10	9	73	23	19	6	10	10	14	14	6	7	10	10	9	8	10	3	5	10		266
13 " .	Boys.	14		24	14	4	5	7		3	3	3		2	4	2	2	1	1		1		90
	Girls.	11	2	34	17	10	7	6	6	7	4		5	4	6	4	3	2	2				130
14 " . .	Boys.	16						1		3	1	3		1	1	1					3		30
15 " . .	"	24						2	4			2	1				1			3	2		38
16 " . .	"	21						1	1	1													24
17 " . .	"	9						1	2														12
18 " . .	"	8								2		2		1	1								14
Total . .		332	46	863	443	260	215	163	161	144	115	92	106	157	121	105	101	80	67	62	98	5	3,836
		1,341																					

a partial reflection of the sound waves by the variously warmed layers of air lying between me and the person examined. Thenceforward the shades were always closed on sunny days.

In Table III. (p. 169) I give a synopsis of the total number of auditory organs examined in the three schools. They are arranged, first, according to their hearing distance at 20, 19, 18, etc., to 0 metres; second, according to their age; and third, according to sex.

The number of those hearing at 20–16 cannot give us a correct idea of the average hearing distance of the normal ear, because in none of the three schools had I a sufficient distance at my disposal for the normal acuteness of hearing. Only the 641 children of the Protestant school could be tested up to a distance of twenty metres, and these too would, to a great extent, have understood my whispered speech still farther away. In the common school, where 1,166 children were examined, the distance was only eighteen metres, and in the dormitory used for the 111 pupils of the Holland Institute, only fifteen metres; for the examination at a greater distance through the open door could not give us satisfactory results. For this reason I have included in Table III. among the best hearing, and in the column for twenty metres, all those who in Holland's Institute could hear beyond fifteen metres, the limits of the hall.

In the Protestant school, too, where I could measure up to twenty metres, that distance, as will be seen from the special Table IV. (p. 171), includes by far the greatest number.

But we must assume that, if the upper limit of the hearing distance had been reached, the numbers would have decreased to the left as much as to the right, where there are those with successively worse hearing.

The results of the collective Table III. are represented in the curve on plate 2, in which those hearing at 20, 19, and 18 metres are brought together under the latter distance. This curve, as may be seen, is rather similar to, but more uniform than, that on plate 1 which was obtained for whispered speech from the 222 auditory organs in Holland's Institute.

TABLE IV.

PROTESTANT SCHOOL II.

Hearing Distance for Whispered Speech of the Single Auditory Organs, in Metres.

Average age.	Class in School.	20 Met.	19 Met.	18 Met.	17 Met.	16 Met.	15 Met.	14 Met.	13 Met.	12 Met.	11 Met.	10 Met.	9 Met.	8 Met.	7 Met.	6 Met.	5 Met.	4 Met.	3 Met.	2 Met.	1 Met.	0 Met.	Total auditory organs.
7 yrs.	Boys' class I.	20	9	8	4	7	5	4	3	6	5	2	6	11	4	4	3	4	2	1	2	—	110
	Girls' " Ia & b	24	19	12	10	5	9	8	2	8	8	4	5	7	6	3	2	1	3	2	—	—	138
8 "	Boys' " II.	15	9	5	7	8	12	4	8	7	7	2	4	7	2	4	9	2	5	3	8	—	128
	Girls' " II.	21	22	5	7	14	5	4	6	2	1	3	4	3	1	5	1	1	—	—	1	—	106
9 "	Boys' " III.	23	16	17	11	10	8	5	10	4	5	1	6	7	2	—	1	1	—	1	2	—	130
	Girls' " III.	18	12	7	8	6	7	6	3	5	5	2	1	5	7	2	2	—	—	1	3	—	100
10 "	Boys' " IV.	16	11	10	15	4	11	9	7	8	5	5	4	9	3	3	5	4	2	2	5	—	138
	Girls' " IV.	17	9	9	5	7	7	5	3	4	3	1	4	7	9	4	3	4	2	1	—	—	104
11 "	Boys' " V.	10	15	7	6	9	1	2	—	7	2	4	1	4	4	4	—	2	3	1	1	1	84
	Girls' " V.	14	6	3	4	3	3	2	4	4	3	3	1	3	—	—	—	—	4	3	—	—	60
12 "	Boys' " VI.	8	7	3	2	3	3	5	4	1	—	1	1	2	3	1	3	—	1	—	2	—	50
	Girls' " VI.	10	9	7	7	5	3	3	1	4	6	2	3	1	2	2	1	2	1	1	4	—	74
13 "	Girls' " VII.	11	2	4	9	3	6	5	3	4	3	—	4	2	2	2	—	—	—	—	—	—	60
	Total,	207	146	97	95	84	80	62	54	64	53	30	44	68	45	34	30	21	23	16	28	1	1282

It shows a decline, at first very rapid, then successively slower, with only two small elevations, one with those hearing at 8 metres, the other with those hearing at 1 metre.

The first elevation finds its most probable explanation in small errors in measurement. Inasmuch as I counted those hearing at 8 metres or less among the pathological cases, which were entered on separate sheets, it may have happened now and then that, where the hearing distance was a little more or less, and the statements varied a good deal, I fixed the hearing distance at 8 metres.

The second small elevation at 1 metre, which comprises all those hearing whispered speech from 1 metre to directly at the ear, has for us a much more important reason. It is the expression of an error in the division we employed for Table III.—an inaccuracy which applies not only to this part of the curve, but to the curve in its whole extent. A simple reflection will show us that the relative length of the several abscissas in plate 2, which forms a graphical representation of the values in Table III., is not correct, and that this curve, therefore, can only give a distorted image of the true relation of the hearing distance in the classified ages examined. That this should be perfectly clear to us is of fundamental importance, not only for these measurements, but for hearing tests in general. An increase of the hearing distance from 1 to 2 metres does not indicate the same difference in hearing power as does an increase, for instance, from 24 to 25 metres. If we take the normal hearing distance for whispered speech at 25 metres, an increase from 1 to 2 metres means a doubling; an increase from 24 to 25 metres, however, only a rise of the hearing distance by one twenty-fifth. The more the functional capacity grows, the more the hearing distance approaches an infinitely large distance; the more it decreases, the nearer it comes to the value 0. Therefore, if we wish to divide the series of those hearing from 0–20 metres into equal quotas, this series must not be arithmetical as given in the table, but it must be geometrical.[1]

[1] The author would have spared himself a good deal of reflection and would have presented the results of his examinations much more comprehensively, if he had adopted the method of recording the acuteness of hearing that expressed

Such a series we obtain in the most simple way if we start from the smallest hearing distance for whispered speech which can be expressed by measure, and let each succeeding higher quota of hearing distance double the value of the next lower one.

In this way I have arrived at the division in Table V. (p. 174) which represents merely another and more correct grouping of Table III.

Luckily I had exactly noted the hearing distance in centimetres with every one hearing at less than one metre—a circumstance found necessary in the compilation of this table.

I started from a distance of 0.03 metre, which represents about the smallest distance at which whispered speech can still be tested. The last column received those from $\frac{1}{\infty}$–0, that is, those who could no longer understand whispered speech at all, but only loud speech, or not even the latter with the respective ear. $\frac{1}{\infty}$ is to be interpreted with reference to whispered speech, and means that the latter could be heard but not understood. The next column comprises those hearing whispered speech between 0.03 and $\frac{1}{\infty}$. In the succeeding column above is each time found the double distance, 0.06–0.03, 0.12–0.06, etc. In the fifth column from the left, 0.25–0.12 was chosen instead of 0.24–0.12, in order to gain farther upward simple figures in metres. The distances corresponding to the equal auditory difference, grow of course, very rapidly toward the end; the last column but one comprises all those hearing between 16–8 metres; the last, all those hearing beyond 16 metres, and thus *includes all those with normal hearing, because the limits of this column extend from* 16–32 *metres.* Thereby, too, the error is nearly eliminated which was caused in Table III. by the varying length of the halls. Only in Holland's Institute the normal cases had to be counted from 15 metres, because this was the length of the hall; while in the other two schools we drew the limit at 16 metres, but this is of so much the less

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the degree of impairment of hearing as a fraction of the normal standard. This method, devised by Snellen (and now universally adopted) for recording the acuteness of vision, has been in general use in America for more than ten years.—H. K.

TABLE V.

Combination of the Schools Examined.

Hearing Distance for Whispered Speech of the Single Auditory Organs, Divided according to Approximately Equal Quotas.

Age.		20 and more —16 Metre.	16–8 Metre.	8–4 Metre.	4–2 Metre.	2–1 Metre.	100–50 Cm.	50–25 Cm.	25–12 Cm.	12–6 Cm.	6–3 Cm.	3 Cm. – 1/8	1/8–0	Total of Auditory Organs Examined.
7 years .	Boys .	167	113	47	14	12	4	7	1	1				366
	Girls .	201	124	41	18	9	4	1	1				1	400
8 " .	Boys .	178	109	43	11	5	6	3	1	1	2	1		360
	Girls .	183	144	59	16	4	4	1	2		1			414
9 " .	Boys .	184	106	38	6	7	1	1	1		2	1	1	348
	Girls .	99	97	48	14	1	5	3			1			268
10 " .	Boys .	192	125	41	12	7	6	3		1	1			388
	Girls .	122	116	46	16	5	4	1	1	3			2	316
11 " .	Boys .	46	39	14	8	1		1					1	110
	Girls .	67	68	23	10	4		1			1			174
12 " .	Boys .	36	32	14	3	1		1	1					88
	Girls .	115	86	37	13	5	1	3	2	2	2			266
13 " .	Boys .	52	25	10	2			1						90
	Girls .	64	45	17	4									130
14 " . .	Boys .	16	8	3			2			1				30
15 " . .	" .	24	9	1		2	1			1				38
16 " . .	" .	21	3											24
17 " . .	" .	9	3											12
18 " . .	" .	8	4	2										14
	Total .	1.784	1.256	484	147	63	38	27	10	10	10	2	5	3,836
	Percentages	46.51	32.74	12.62	3.83	1.64	0.99	0.70	0.26	0.26	0.26	0.05	0.13	100
		79.25		20.75										

consequence as most of those there tested could still understand through the open door.

According to Vierordt's experimental investigations "on the weakening of sound when propagated through the air,"[1] the intensity of sound when heard through the air does not decrease in the proportion of the square of the distance from the source of the sound, which appears to be a necessary physical postulate, but sound intensity and distance stand in a simple inverse ratio. Accordingly, we must assume as approximately equal in extent the quotas of perception placed in juxtaposition in my Table V. in the several columns; of course this would be strictly correct only if the examinations had been made in the open air. In a closed space Vierordt found the relation determined in the open air confirmed only with very weak sources of sound; the more intense the source of sound employed in a closed space, the slighter was the decrease of the intensity of sound with increasing distance, reflection from the walls gaining correspondingly in importance. For this reason we may consider as actually equal in Table V. only the quotas of perception in the columns of those hearing at small distances; while with the increase of the hearing distance the reflection from the walls enters more and more as a favoring factor for an increase of the hearing distance, and hence the quotas of perception toward the normal hearing distance must in reality be assumed as successively smaller.

In order to show how uniform are the results of the examinations in this natural system of division, I subjoin here in Tables VI., VII., and VIII. the several schools in the same division as in Table V. which is composed of them.

Very remarkable to me was the result of the graphic representation—the curve plate 3—which was obtained from Table V., the same as the curve plate 2 was obtained from Table III.

While in the latter curve we have found the above-mentioned two elevations, this new curve shows an almost regular course, and in its form nearly approaches a parabola.

[1] *Zeitschrift f. Biologie von Pettenkofer und Veit*, Bd. xviii., p. 383.

TABLE VI.

HOLLAND'S INSTITUTE.

Hearing Distance for Whispered Speech of the Single Auditory Organs, Divided according to Approximately Equal Quotas.

Age.	15 and more. Met.	Below 15–8 Met.	8–4 Met.	4–2 Met.	2–1 Met.	100–50 Cm.	50–25 Cm.	25–12 Cm.	12–6 Cm.	6–3 Cm.	3 Cm. – $\frac{1}{\infty}$	$\frac{1}{\infty}$–0	Total of Auditory Organs Examined
10 years	9	7			1		1						18
11 "	8	13	2	3									26
12 "	16	14	5	2	1								38
13 "	14	6	1	1									22
14 "	16	8	3			2			1				30
15 "	24	9	1		2	1			1				38
16 "	21	3											24
17 "	9	3											12
18 "	8	4	2										14
Total	125	67	14	6	4	·3	1		2				222

Quite similar, too, are the curves of each of the three schools separately, appearing on plate 4. The deviations of their forms are caused to a great extent only by the very variable number of those examined in the several schools. The course of the curves in general, however, is very uniform, and in not one of them do we see similar elevations such as we have met in Curves II. and I.

In dividing the hearing distances according to approximately equal quotas in the way I have selected, it appears, both from the regularity in the course of the curve comprising the total number of the pupils, and from the resemblance—to each other as well as to the total curve—of the graphic representations obtained from the several schools, that a general uniformity in the distribution of the various grades of capacity of the ear exists in the whole of a population of an equal age, which has astonished me. From the uniformity of our results in the several schools, and from the regular course of the curves gained from them, we are also justified in drawing the reciprocal conclusion that the present hearing examinations are reliable, and that whispered speech may be looked upon as an accoumeter sufficiently answering our expectations.

From these considerations it follows as a practical rule

TABLE VII.

Common School II. A.

Hearing Distance for Whispered Speech of the Single Auditory Organs, Divided according to Approximately Equal Quotas.

Average Age.	Class in School.	18 and more —16 Metre.	16–8 Metre.	8–4 Metre.	4–2 Metre.	2–1 Metre.	100–50 Cm.	50–25 Cm.	25–12 Cm.	12–6 Cm.	6–3 Cm.	3 Cm. —$\frac{1}{8}$	$\frac{1}{8}$—0	Total of Auditory Organs Examined.
7 yrs.	Boys' class Ia, b, & c	126	75	25	8	11	4	6	1					256
	Girls' " Ia, b, & c	136	75	23	14	7	4	1	1				1	262
8 "	Boys' " IIa & b	142	57	21	4	2	4				2			232
	Girls' " IIa, b, & c	128	105	49	15	3	4	1	2		1			308
9 "	Boys' " IIIa & b	117	57	28	5	6		1			2	1	1	218
	Girls' " IIIa & b	54	62	32	14		4	2						168
10 "	Boys' " IVa & b	131	65	21	6	4	1	2		1	1			232
	Girls' " IVa & b	82	82	23	10	4	4	1	1	3			2	212
11 "	Girls' " V . .	40	45	20	6	1		1			1			114
12 "	Girls' " VIa & b	82	59	31	10	4		2	2	2				192
13 "	Boys' " VII . .	38	19	9	1			1						68
	Girls' " VII . .	38	17	11	4									70
	Total . . .	1,114	718	293	97	42	25	18	7	6	7	1	4	2,332

TABLE VIII.

Protestant School II.

Hearing Distance for Whispered Speech of the Single Auditory Organs, Divided according to Approximately Equal Quotas.

Average Age.	Class in School.	20 and more —16 Meter.	16–8 Meter.	8–4 Meter.	4–2 Meter.	2–1 Meter.	100–50 Cm.	50–25 Cm.	25–12 Cm.	12–6 Cm.	6–3 Cm.	3 Cm. $-\frac{1}{\infty}$	$\frac{1}{\infty}-0$	Total of Auditory Organs Examined.
7 yrs.	Boys' class I	41	38	22	6	1		1		1				110
	Girls' " Ia & b	65	49	18	4	2								138
8 "	Boys' " II	36	52	22	7	3	2	3	1	1		1		128
	Girls' " II	55	39	10	1	1								106
9 "	Boys' " III	67	49	10	1	1	1		1					130
	Girls' " III	45	35	16		1	1	1			1			100
10 "	Boys' " IV	52	53	20	6	2	5							138
	Girls' " IV	40	34	23	6	1								104
11 "	Boys' " V	38	26	12	5	1		1					1 (loud speech 5 Cm.)	84
	Girls' class V	27	23	3	4	3								60
12 "	Boys' " VI	20	18	9	1			1	1					50
	Girls' " VI	33	27	6	3	1	1	1			2			74
13 "	Girls' " VII	26	28	6										60
	Total	545	471	177	44	17	10	8	3	2	3	1	1	1,282

for our tests of the hearing, that a special stress should be laid on an accurate determination of the small hearing distances of persons with impaired hearing, and that a difference of one centimetre in the hearing distance close to the ear implies much more than a difference of one metre or more at the limit of the normal hearing distance.

The total results of this review of the hearing distance of the several auditory organs is the following :

If we consider as pathological only those auditory organs which hear at 8 metres or less—that is, one-third of the normal distance and below, and count among the normal all those hearing beyond one-third, we get, as the result of the 3,836 auditory organs examined, 79.25 *per cent. normal and* 20.75 *per cent. pathological.*

The following tables give an insight into the apportionment of impaired hearing among the *individuals.* In Tables IX., X., and XI. is given in the first place the hearing distance of the several individuals, divided with reference to unilateral and bilateral affection, in each of the three schools examined.

Leaving out of consideration Holland's Institute, where there were only 18 per cent. hearing at less than one-third —a fact easily explained, as persons with greatly impaired hearing rarely resolve to attend the higher grades of schools,—the result yielded from the two public schools is pretty uniform.

In the common school there were found among 1,166 pupils 73.5 per cent. with perfectly or approximately normal hearing, and 26.5 per cent. hearing on one or both sides at less than one-third; in the Protestant school, 74.1 per cent. with entirely or nearly normal hearing, and 25.9 per cent. hearing on one or both sides at less than one-third.

If we tabulate the individuals of *all* of the three schools according to their average ages, as has been done in table XII. (p. 183), we obtain 74.2 per cent. with normal hearing, and 35.8 ear patients; of these, 6.7 per cent. hear on *both sides* at less than 8 metres, and 5 per cent. on *both sides* at less than 4 metres.

TABLE IX.

HOLLAND'S INSTITUTE.

Hearing Distance for Whispered Speech of the Individuals, Divided with Reference to Unilateral and Bilateral Affection.

Class.	Beyond 15 metres on both sides.	15-8 Metres		Total persons hearing *above* 8 metres on both sides.	8-4 Metres		4-0 Metres		Total persons hearing on one and both sides *below* 8 metres.	Number of pupils examined.
		on one side (other side above 16 metres).	on both sides.		on one side (other side above 8 metres).	on both sides.	on one side (other side above 4 metres).	on both sides.		
Latin class I										
Average 10 years	4	1	3	8				1	1	9
Latin class II										
Average 11 years	4	2	4	10	1		1	1	3	13
Latin class III										
Average 12 years	7	2	5	14	3		1	1	5	19
Latin class IV										
Average 13 years	6	1	2	9	1		1		2	11
Latin class V										
Average 14 years	7	1	3	11	1	1	1	1	4	15
College class I										
Average 15 years	11	1	4	16	1			2	3	19
College class II										
Average 16 years	9	3		12						12
College class III										
Average 17 years	4	2		6						6
Upper class										
Average 18 years	4		1	5	2				2	7
Total . . .	56	13	22	91	9	1	4	6	20	111
Percentages .	50.5	11.7	19.8	82.0	8.1	0.9	3.6	5.4	18.0	100

If we compare the relative frequency of persons with impaired hearing in *the different ages of life*, the percentages of those having less than one-third of the normal acuteness of hearing in the first four years of school life, from the sixth to the tenth, show but slight variations, between 25 and 26.1 per cent. Greater variations, between 19.1 and 31 per cent., were found in the years from 11 to 13. But here the total numbers of those examined are much smaller, and the figures obtained, therefore, less demonstrative; if we summarize these three years, we again obtain an average value approximating to the one above, viz., 26.5 per cent. At the age from 14 to 18 years, the number examined was too small to justify us in drawing any conclusions.

TABLE X.

Common School II. A.

Hearing Distance for Whispered Speech, Divided with Reference to Unilateral and Bilateral Affection.

Average age.	Class.	Above 16 metres on both sides.	16–8 Meters: on one side (other side above 16 met.).	16–8 Meters: on both sides.	Total persons hearing on both sides *above* 8 metres.	8–4 Metres: on one side (other side above 8 metres).	8–4 Metres: on both sides.	4–0 Metres: on one side (other side above 4 metres).	4–0 Metres: on both sides.	Total persons hearing on one and both sides *below* 8 met.	Number of pupils examined.
7 years	Boys' class Ia, b, and c .	53	18	23	**94**	10	5	8	11	**34**	128
	Girls' " Ia, b, and c .	52	23	23	**98**	6	7	11	9	**33**	131
8 "	Boys' " IIa and b .	61	18	16	**95**	7	5	6	3	**21**	116
	Girls' " IIa, b, and c .	53	19	36	**108**	12	13	16	5	**46**	154
9 "	Boys' " IIIa and b .	50	15	16	**81**	10	7	6	5	**28**	109
	Girls' " IIIa and b .	21	11	21	**53**	9	6	12	4	**31**	84
10 "	Boys' " IVa and b .	57	15	22	**94**	7	5	5	5	**22**	116
	Girls' " IVa and b .	32	18	28	**78**	7	5	7	9	**28**	106
11 "	Girls' " V . . .	12	15	9	**36**	10	5	3	3	**21**	57
12 "	Girls' " VIa and b .	34	13	19	**66**	6	11	6	7	**30**	96
13 "	Boys' " VII . .	15	8	5	**28**	1	3	2		**6**	34
	Girls' " VII . .	15	8	3	**26**	2	3	4		**9**	35
Total		455	181	221	**857**	87	75	86	61	**309**	1,166
Percentages of the totals . .		39.1	15.5	19.0	**73.5**	7.5	6.4	7.4	5.2	**26.5**	100

TABLE XI.

Protestant School II.

Hearing Distance for Whispered Speech, Divided with Reference to Unilateral and Bilateral Affection.

Average age.	Class.	Above 16 met. on both sides.	16–8 Metres: on one side (other side above 16 met.).	16–8 Metres: on both sides.	Total persons hearing on both sides *above* 8 met.	8–4 Metres: on one side (other side above 8 metres).	8–4 Metres: on both sides.	4–0 Metres: on one side (other side above 4 metres).	4–0 Metres: on both sides.	Total persons hearing on one and both sides *below* 8 met.	Number of pupils examined.
7 years	Boys' class I	17	7	13	**37**	5	7	3	3	**18**	55
	Girls' " Ia and b	27	8	19	**54**	5	5	4	1	**15**	69
8 "	Boys' " II	14	7	17	**38**	11	4	4	7	**26**	64
	Girls' " II	22	11	13	**46**	2	4		1	**7**	53
9 "	Boys' " III	29	9	17	**55**	4	3	2	1	**10**	65
	Girls' " III	18	9	11	**38**	4	6		2	**12**	50
10 "	Boys' " IV	21	10	18	**49**	6	4	7	3	**20**	69
	Girls' " IV	17	6	12	**35**	2	9	5	1	**17**	52
11 "	Boys' " V	15	6	8	**29**	3	4	4	2	**13**	42
	Girls' " V	13	1	9	**23**	3		1	3	**7**	30
12 "	Boys' " VI	8	4	4	**16**	5	2	1	1	**9**	25
	Girls' " VI	15	3	11	**29**	2	2		4	**8**	37
13 "	Girls' " VII	10	6	10	**26**	2	2			**4**	30
	Total	226	87	162	**475**	54	52	31	29	**166**	641
	Percentages of the totals	35.3	13.6	25.3	**74.1**	8.4	8.1	4.8	4.5	**25.9**	100

TABLE XII.

Prevalence of Unilateral and Bilateral Impaired Hearing among the Different Ages.

Age.	Above 16 met. on both sides.	16–8 Metres		Total persons hearing on both sides *above* 8 met.	8–4 Metres		4–0 Metres		Total persons hearing on one and both sides *below* 8 met.	Number of pupils examined.	Total persons hearing on one and both sides below 8 met. in percentages.
		on one side (other side above 16 met.).	on both sides.		on one side (other side above 8 met.).	on both sides.	on one side (other side above 4 met.).	on both sides.			
7 years .	149	56	78	**283**	26	24	26	24	**100**	383	26.1
8 " .	150	55	82	**287**	32	26	26	16	**100**	387	25.8
9 " .	118	44	65	**227**	27	22	20	12	**81**	308	26.0
10 " .	131	50	83	**264**	22	23	24	19	**88**	352	25.0
11 " .	44	24	30	**98**	17	9	9	9	**44**	142	31.0
12 " .	64	22	39	**125**	16	15	8	13	**52**	177	29.4 } 26.5
13 " .	46	23	20	**89**	6	8	7		**21**	110	19.1
14 " .	7	1	3	**11**	1	1	1	1	**4**	15	
15 " .	11	1	4	**16**	1			2	**3**	19	
16 " .	9	3		**12**						12	
17 " .	4	2		**6**						6	
18 " .	4		1	**5**	2				**2**	7	
Total .	737	281	405	**1,423**	150	128	121	96	**495**	1,918	
Percentages of the totals	3.85	14.6	21.1	**74.2**	7.8	6.7	6.3	5.0	**25.8**	100	

TABLE XIII.

Prevalence of Unilateral and Bilateral Impaired Hearing, according to Sex.

		Above 16 Metres on both sides.	16-8 Metres		Total persons hearing on both sides *above* 8 Metres.	8-4 Metres		4-0 Metres		Total persons hearing on one and both sides *below* 8 Metres).	Number of pupils examined.
			on one side (other side above 16 Metres).	on both sides.		on one side (other side above 8 Metres).	on both sides.	on one side (other side above 4 Metres).	on both sides.		
Boys	Common School II. A	236	74	82	**392**	35	25	27	24	**111**	503
	Protestant School II. A	104	43	77	**224**	34	24	21	17	**96**	320
	Holland's Institute	56	13	22	**91**	9	1	4	6	**20**	111
Girls	Common School II.	219	107	139	**465**	52	50	59	37	**198**	663
	Protestant School II.	122	44	85	**251**	28	28	10	12	**70**	321
	Total boys	396	130	181	**707**	78	50	52	47	**227**	934
	" girls	341	151	224	**716**	72	78	69	49	**268**	984
	Total boys in percentages	42.4	13.9	19.4	**75.7**	8.4	5.4	5.6	5.0	**24.3**	100
	" girls " "	34.9	15.3	22.8	**72.8**	7.3	7.9	7.0	5.0	**27.2**	100

From the results of his investigations, Weil has drawn the conclusion that even in the school years disturbances of hearing rise in frequency with increasing age; this author, to be sure, has examined a larger number of older pupils in the middle schools than were at my disposal. The numbers I have given above do not testify in favor of a material increase of impaired hearing even in the school age, and I must confess that from the start I did not expect any confirmation in this direction, bearing in mind the analogous conditions in the eye. For, in the latter, too, a gradual decline in the functional capacity can be demonstrated with increasing age, and Donders [1] caused his pupil de Haan to make investigations in this direction on a larger number of normal eyes. Their results, however, showed a clearly marked decline of the visual acuteness from the thirtieth year of life. We could expect to find similar conditions also in tests of the hearing power. That the increase of impaired hearing in old age is quite enormous I have convinced myself by testing the acuteness of hearing in a home for the aged, about which I shall report in a subsequent paper.

Finally, in Table XIII. is given a synopsis of unilateral and bilateral impairment of hearing according to the sexes. There are among the boys, 75.7 per cent. normal, and 24.3 per cent. hearing at less than one-third; girls, 72.8 per cent. normal, and 27.2 per cent. hearing at less than one-third.

This small difference between boys and girls in favor of the former is sufficiently explained by the comparatively better results among the Latin scholars and college boys of the Holland Institute, for which the reason has been given above.

If we compare the percentages of defective hearing found in the several schools, and at the different ages examined, and in the two sexes, we find a coincidence which must appear remarkable enough.

As the total average we obtain 25.8 *per cent., or nearly* 26 *per cent., possessing only one-third or less of the normal hear-*

[1] "Anomalien der Refraction und Accommodation," 1866, p. 161.

ing distance. 14.5 *per cent. of the whole—of which* 7.8 *per cent. unilaterally and* 6.7 *per cent bilaterally—perceive whispered speech, heard by the normal ear at* 20–25 *metres, only at* 8–4 *metres; and* 11.3 *per cent of the whole—of which* 6.3 *per cent. unilaterally and* 5.0 *per cent. bilaterally—hear the whisper only between* 4–0 *metres.*

Aside from ascertaining the hearing distance of a larger number of auditory organs and its distribution among individuals, the main task I had set myself in my investigations in schools was directed to the etiology of diseases of the ear, so far as it could be reached by way of statistics, and to the occurrence of the several subjective and objective phenomena which are regarded as symptoms of disease, as affecting on the one hand persons with normal, and on the other hand those with defective hearing of various degrees.

It would have taken too long a time to arrive at the history by verbal inquiry, and besides, at least in the youngest children, would have been effected but very imperfectly. Therefore, the children were given each a question blank, to be filled by their parents or relatives before coming under examination. The teachers had agreed to specially request the parents through the children to answer the questions carefully, even in cases where there was no disease of the ear. The questions comprised: (1) Former or present purulent discharge; (2) Previous diseases of children; (3) Possible connection of the otorrhœa with the latter; (4) The presence of any hereditary tendency. I append the contents of the blank:

Blank for Ascertaining Former or Present Affections of the Ear.

Given Name.	Surname.	Date of Birth.	Class in School.

1. Has a discharge from one or both ears been observed formerly, and at what age?

2. Up to what age did the discharge remain? Was it periodical or continuous? Offensive or not?

3. What diseases have been present? The most important in this inquiry are: scarlet-fever, measles, rubeolæ, other eruptions of the skin, diphtheria, cerebro-spinal meningitis.

4. Did the discharge from the ear first occur during one of these diseases, and how long after the appearance of the eruption or after the beginning of the disease?

5. Brief mention of other diseases (formerly or still present) of the right or left or both ears; pains, ringing, occasional defective hearing?

6. Is either of the parents, of the paternal or maternal grandparents, of the brothers, sisters, uncles, aunts, or their children deaf? On one or both sides? With or without discharge from the ear? Deaf from birth or become so at what age?

The blanks had been filled up pretty completely so far as this could be expected with the varying grade of education of the relatives. The different orders of society were represented in the two public schools about in proportion to the total population. In examining the blanks I have convinced myself how slight the demands must be which we make of the average population in such statistical investigations. Thus, for instance, it frequently happened that under question 3 a number of diseases were enumerated and the answer to question 4 read briefly: "After the disease," etc. Therefore it was not possible to arrive at any certain conclusion directly from the blanks as to how often present or past otorrhœas should be attributed to one or other of the acute infectious diseases. In harmony with the universal experience of otologist, scarlatina was most frequently named as the starting-point of suppuration of the ear. The next most frequent primary disease was measles. Once only is the beginning of the discharge reported during true diphtheria, once with rubeolæ, and once with "chicken-pox." In the latter case, three brothers and sisters were suffering at the same time from bilateral discharge; whether all of them in consequence of varicella is not stated. A special dislike is manifested in a small part of the population against vaccination, to which otorrhœa was repeatedly attributed. One father even states that

ever since then there had appeared, besides the discharge, some eruptions and a sore on the arm which still remained. If we take into consideration the acute inflammatory alterations of all grades which are exceedingly frequent, and which Wendt found in the middle ear in his numerous autopsies of small-pox patients, we can justly assert that vaccination offers protection rather than danger for the ear likewise.

In tabulating the different acute infectious diseases, I had to proceed in part somewhat arbitrarily. Thus I have enumerated the terms "Fleckeln, red spots, Frieseln" among measles, croup under diphtheria. Where scarlatina, diphtheria, and possibly some other diseases are reported, it is generally impossible from the statements to ascertain whether the diphtheria appeared only as a concomitant of the scarlatina or at another time; therefore in these cases both had to be entered separately. Despite the various sources of error above mentioned, I do not hold the results of these investigations regarding the acute infectious diseases and the statistics of morbidity in general to be worthless, especially as it is difficult in one of the larger cities to gain, in some other way than the one here followed, a complete insight into a larger number of persons of like age. We shall see below to what extent the total figures here obtained point to a dependence of the ear disease upon the general affections taken into consideration.

The children provided with their filled-in blanks were tested first for their hearing distance of whispered speech, and on one of the succeeding days examined with the otoscope; the otoscopical examination included all the children, both those with normal and those with defective hearing; in Holland's Institute this was done by artificial light, in the two public schools by daylight. Where perforation of the drumhead could not be perceived directly, but appeared probable from the other findings, I have employed auscultation during the performance of Politzer's procedure in order to settle the question.

The results of the examination of each person were entered into the following blank (here reduced):

SCHOOL. CLASS. PLACE OF EXAMINATION.

No.	Given name.	Surname.	Age.	Side.	Hearing distance for low speech.	Cerumen. Not plugging.	Cerumen. Plugging.	Drumhead. Reflexes.	Drumhead. Color and calcification.	Drumhead. Anomalies of form.	Drumhead. Perforation.	Otorrhœa.	Pharynx.	Remarks.
1				R L										
2				R L										

The normal relation, as well as all the several deviations from it which showed themselves on the drumhead, were carefully noted and entered into the three columns, "Reflexes, Color and calcification, and Anomalies of form." The intention I had in view was to ascertain statistically how frequent are the several deviations on the drumhead which we know, for instance, as characteristic of depression, etc., together with real disturbances of hearing still present; I intended to test all the anomalies of the drumhead in their order as bearing on our diagnosis. The work was rather laborious and slow, but I know no other way by which it would be possible to obtain positive knowledge as to which alterations on the drumhead are of actual pathological importance, and which still belong to the normal condition, unless it be the examination of a larger number of individuals out of the total population.

I have laid special stress on a careful tabulation of all the drumhead reflexes present, both regular and irregular, so as to get a clear conception at last to what extent the altered curvatures of the drumhead, of which they are the expression, have to be weighed in reference to the function of the ear and to our diagnosis.

If we familiarize ourselves with the origin of the drumhead reflexes and their manifold changes under pathological conditions, otoscopy ranges itself by the side of the best medical methods of examination in our possession, by giving us information of a number of relatively very slight alterations of form, which often can be recognized by this means alone,

and which are able to furnish important landmarks for our diagnosis.

Helmholtz was the first to point out, and Politzer has proved by experiment, that the normal triangular reflex can be produced only at the point where the drumhead meets our visual axis vertically.

Whenever we extend this axiom to all the other, both normal and pathological, reflexes of the drumhead, they will become clear to us in their mode of origin, and permit us to draw positive deductions as to the special changes of form underlying their source. I have, on a previous occasion,[1] given the explanation of the formation of a number of reflexes in connection with a schematic section of the auditory canal and drumhead. Inasmuch as the drawing in the *Berliner klinische Wochenschrift* did not exactly come up to

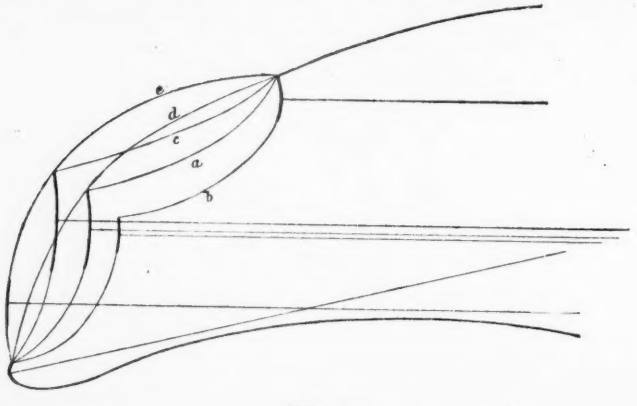

Fig. 1.

my expectations, I subjoin it again here in Fig. 1. In Fig. 2 are marked all the reflexes on the drumhead which occur under normal conditions of curvature.

The section (Fig. 1) passes through the axis of the auditory canal in such a way as to cut the triangular reflex of the drumhead lengthwise into halves—that is to say, divide the drumhead as indicated in Fig. 2. So far as this sectional line runs through the normal reflex, it is met vertically by our visual axis. The fact that the direction of the

[1] "Die Verschliessung der Tuba Eustachii, ihre physikalische Diagnose und Einwirkung auf die Function des Ohres." Vortrag, gehalten im ärztlichen Bezirksverein zu München.—*Berliner klin. Wochenschr.*, 1883, No. 36.

reflex runs downward and forward is due to the double inclination of the drumhead; its triangular form depends on the obtuse-angled funnel-shape of the membrane, as Trautmann has shown. In order to get an idea of the origin of the triangular form, we may imagine that from the periphery of the reflex to the umbo a series of infinitely small transverse sections of hollow cylinders follow each other, every succeeding one of which corresponds to a cylinder having a smaller basal radius.

The section through the *normal* drumhead (Fig. 1, *a*) shows at once why the triangular reflex has exactly the

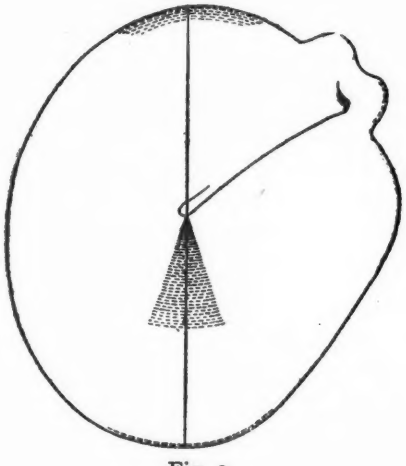

Fig. 2.

length found on the average under normal conditions and cannot reach the periphery.

The drumhead section *b*, in which the membrane is drawn bulged out by condensation of the air in the cavities of the middle ear, shows how, on the one hand, the triangular reflex shortens in this position; on the other, a second reflex of convexity appears on the posterior upper periphery, where now likewise a part comes to lie vertically to our visual axis.

Sections *c*, *d*, and *e* show different grades of depression of the drumhead, by reason of rarefaction of the air in the middle ear.

In section *c* the convexity of the surface of the funnel is

diminished, but the funnel shape is still preserved; the triangular reflex, therefore, has become longer, and narrower on its base.

In section *d* the surface of the funnel, by preponderance of the external atmospherical pressure, has become outwardly concave just as much as it is externally convex on the normal drumhead; the place of the umbo, which was moved inwards during the simple straightening of the radial fibres drawn in section *c*, has now returned to its normal place, and the funnel shape of the drum has changed into that of a shallow pan. In this section no part of the drumhead met by our visual axis is vertical to it, hence every reflex is absent.

Finally, in section *e*, owing to a stretching of the radial fibres, the concavity of the entire drumhead outwardly has still more increased, and now a reflex again occurs—that is, a true concave speculum reflex, which, however, no longer begins in the umbo, but has moved far away from the umbo toward the periphery, forward and downward. This reflex, of course, can no longer possess a triangular form, because the funnel shape of the drum has been lost, but represents a roundish, square, or irregular spot, often having a remarkably bright lustre. Magnus[1] already noticed this roundish reflex displaced toward the periphery, in his studies on the behavior of the organ of hearing in compressed air, but interpreted it as the consequence of a greater local depression merely.

Another *linear* glossy streak is found almost exclusively along the anterior lower periphery of the drumhead, provided the structure of the auditory canal permits of its being seen. This reflex arises, as I have convinced myself, no longer exclusively in the drumhead itself, but lies in the groove between the limbus of the drum and the external lip of the sulcus. This glossy streak, which I have termed "sulcus reflex," as well as the above-mentioned reflex of convexity, which arises at the posterior upper periphery during bulging of the drumhead, are cut *in half* under regular conditions by our line of section, the same as the

[1] *Arch. f. Ohrenheilk.*, Bd. i., p. 273.

triangular reflex. I shall explain below why I have directed particular attention to this reflex streak, and entered it in all cases in my investigations in schools.

Two small reflexes remain to be mentioned, which may be present under normal conditions. The one is at the point of the short process when its cartilaginous investment is more strongly developed so as to form a roundish knob. The other is produced in a similar manner as the sulcus reflex at the anterior upper margin of the membrana Shrapnelli.

All the other reflexes occurring on the drumhead are of a pathological nature, and owe their origin to alterations of form of the membrane.

A number of them occur in the nearest surroundings of the short process as the expression of its greater prominence. Thus must be interpreted as pathological the normally small linear reflex of the membrana Shrapnelli whenever it becomes spot-like, also the glossy point on the short process whenever it extends as a line, no matter how short, on the so-called posterior fold. *Above* this fold too, one or several reflexes may occur; or else the entire approximately triangular surface lying above it, as far as the periphery, may shine uniformly when it represents either a level plane or a concavity which is met vertically by our visual axis.

By far the majority of the pathological reflexes present at unusual places of the drumhead are reflexes of concavity, and characterize local depressions and, when the borders of the depression are more sharply circumscribed, cicatrices, or, when spread over a larger portion of the drumhead, atrophy and collapse of the latter. They give us a very distinct picture of the alterations of form present, especially in conjunction with the reflexes of convexity occurring after the air douche on corresponding or neighboring places.

It may be learned from the résumé here given, which contains in brief my experience gained in an extensive clinical observation respecting the occurrence of drumhead reflexes, that their origin can be explained throughout in a simple manner, from the same point of view.

It was indispensable for the purpose of this paper to enter more fully here into the formation of the normal and

pathological drumhead reflexes ; for the statistical results to be reported in the following pages are to be considered, as it were, as a test of the correctness of the clinical experience regarding their pathological importance and their diagnostic value.

In order to gain a serviceable view of the large mass of single observations which I had jotted down into the above blanks, the several phenomena found on the drumhead were entered in their order of frequency in the following tables XIV.–XIX., and grouped in them with reference to the hearing distance present at the same time. The hearing distances found were brought into four larger divisions, the last of which comprises those auditory organs which hear whispered speech between 0–4 metres, and every next preceding column the organs with double the hearing distance of that immediately below—that is, with 4–8, 8–16, 16 and more metres.

Besides the normal and pathological appearances of the the drumhead, the occurrence of otorrhœa and of occluding and non-occluding accumulations of cerumen was likewise noted in these tables with reference to the hearing distance present at the time. Finally, in the same tables were recorded all the data reported as to former ear affections, general diseases, trauma, and hereditary taint. I should have preferred to extend my investigations to the cranio-tympanic conduction, the perception of the higher tones, Rinne's experiment, etc.; but neither the time granted me for the examination by the authorities nor my own would have sufficed for these time-consuming methods; these, which certainly could give many new statistical landmarks as to the value of these various modes of examination, I must leave for some future investigator, who will also find the way better prepared for him when the interest in hearing tests of school-children will have become more general.

I subjoin here the tabular statement of the several pathological alterations and the items of historical interest. Tables XIV.–XVI. (pp. 196–201) give the particulars of each of the schools examined; tables XVII. and XVIII.

(pp. 202–205), of the number of boys and girls in the two public schools; table XIX. (p. 206), of the total number of children in the two public schools.

The several numbers of the four columns in each table, which contain the four different quotas of hearing, can, then, only be compared with each other, when we refer every number found to an equal number of persons examined. For this reason in the *right* half of every table the several numbers are calculated for one hundred persons examined in every single column—that is, stated in percentages of the single column. In the same way the total number of persons examined, which is contained in the last column, is expressed in percentages.

In Holland's Institute the number of Latin scholars and college boys examined was too small to render the division of the hearing distance into four columns feasible. Therefore only two columns were made, containing respectively the auditory organs perceiving *below* eight metres, and those *above* eight metres. For this reason I was unable to utilize further in tables XVII.–XIX. the data of table XVI., which contains the prevalence of pathological alterations and the items of history in Holland's Institute.

In this school, too, some consideration was given to the *pharyngeal space* in all the persons examined, so far as simple inspection from the mouth will permit it. The results of the examination noted in the table do not allow us to recognize any preponderance of impaired hearing in connection with pharyngeal affections visible from the mouth.

I found:

Hearing Distance.	Absolute numbers.			Percentages.		
	Above 8 Met.	Below 8 Met.	Total.	Above 8 Met.	Below 8 Met.	Total.
Total number examined . .	192	30	222	100	100	100
Hypertrophied tonsils . .	33	5	38	17.2	16.7	17.1
Pharyngitis diffusa . . .	38	6	44	19.8	20.0	19.8
Pharyngitis granulosa . .	12		12	6.3		5.4
Lateral tumors	27	3	30	14.1	10.0	13.5
Nasal speech	1	5	6	0.5	16.7	2.7

TABLE XIV.

Common School II. A.

Boys and Girls.

Hearing distance for whispered speech.		Number of auditory organs.				Total.	In percentages of each column.				Total.
		Above 16 Metre.	16–8 Metre.	8–4 Metre.	4–0 Metre.		Above 16 Metre.	16–8 Metre.	8–4 Metre.	4–0 Metre.	
Total auditory organs perceiving at the above distances in the schools		1114	718	293	207	2332	100	100	100	100	100
Cerumen	*a* Hindering examination	79	60	18	10	167	7.1	8.4	6.1	4.8	7.2
	b Apparently occluding	8	17	7	14	46	0.7	2.4	2.4	6.8	2.0
Normal drumhead reflexes	Triangular spot in or near the umbo	968	584	196	83	1831	86.9	81.3	66.9	40.1	78.5
	Sulcus reflex covered by the anterior lower wall of the ear canal	402	251	106	49	808	36.1	35.0	36.2	23.7	34.6
Pathological state of the drumhead reflexes	Normal reflex absent	20	37	20	21	98	1.8	5.2	6.8	10.1	4.2
	Normal reflex far removed from the umbo toward the periphery	22	26	34	36	118	2.0	3.6	11.6	17.4	5.1
	Macular reflex *above* the short process	8	8	4	3	23	0.7	1.1	1.4	1.4	1.0
	Punctiform linear or more expanded reflex *behind* the short process	18	26	17	12	73	1.6	3.6	5.8	5.8	3.1
Color anomalies of the drumhead	Diffuse reddening or extravasation of blood	2	2	1	2	7	0.2	0.3	0.3	1.0	0.3
	Serum perceptible in the drum cavity		1	2	3	6		0.1	0.7	1.4	0.3
	Diffuse opacity	15	14	14	12	55	1.3	2.0	4.8	5.8	2.4
	Circumscribed opacities	114	104	49	20	287	10.2	14.5	16.7	9.7	12.4
	Calcifications	14	6	8	7	35	1.3	0.8	2.7	3.4	1.5
	Posterior streak of opacity	56	42	21	11	130	5.0	5.9	7.2	5.3	5.6
Form anomalies of the drumhead	Posterior fold	50	58	48	50	206	4.5	8.1	16.4	24.2	8.8
	Manubrium mallei widened or short process projecting	9	17	12	7	45	0.8	2.4	4.1	3.4	1.9
	Atrophy	7	8	8	5	28	0.6	1.1	2.7	2.4	1.2
	Cicatrix	10	16	14	10	50	0.9	2.2	4.8	4.8	2.2

TABLE XIV.—*Continued.*

COMMON SCHOOL II. A.

Boys and Girls.

Hearing distance for whispered speech.		Number of auditory organs.					In percentages of each column.				
		Above 16 Metre.	16–8 Metre.	8–4 Metre.	4–0 Metre.	Total.	Above 16 Metre.	16–8 Metre.	8–4 Metre.	4–0 Metre.	Total.
Perforation of the drumhead	With otorrhœa			2	25	27			0.7	12.1	1.2
	Without otorrhœa	5	6	7	11	29	0.4	0.8	2.4	5.3	1.2
	Nasal speech		6	9	13	28		0.8	3.1	6.3	1.2
Former ear affections	Former discharge	55	58	50	64	227	4.9	8.1	17.1	30.9	9.7
	Former impaired hearing	20	33	24	55	132	1.8	4.6	8.2	26.6	5.7
	Former tinnitus	24	19	17	12	72	2.2	2.6	5.8	5.8	3.1
	Former earache	48	59	26	24	157	4.3	8.2	8.9	11.6	6.7
Other history	Scarlatina	240	159	67	58	524	21.5	20.2	22 9	28.0	22.5
	Morbilli	555	375	165	105	1200	49.8	49.7	56.3	50.7	51.5
	Rubeola	254	177	56	39	526	22.8	24.7	19.1	18.8	22.6
	Diphtheria	235	166	65	62	528	21.0	23.1	22.2	30.0	22.6
	Meningitis	23	17	5	3	48	2.1	2.4	1.7	1.4	2.1
	Trauma			2		2			0.7		0.1
	Heredity	100	62	27	31	220	9.0	8.6	9.2	15.0	9.4
	Not examined with speculum on account of disease, etc.	24	20	10	4	56					

TABLE XV.

Protestant School II.

Boys and Girls.

Hearing distance for whispered speech.		Number of auditory organs.					In percentages of each column.				
		Above 16 Metre.	16–8 Metre.	8–4 Metre.	4–0 Metre.	Total.	Above 16 Metre.	16–8 Metre.	8–4 Metre.	4–0 Metre.	Total.
Total auditory organs perceiving at the above distances in the school.		545	471	177	89	1282	100	100	100	100	100
Cerumen	*a.* Hindering examination	73	67	15	13	168	13.4	14.2	8.5	14.6	13.1
	b. Apparently occluding	9	12	9	18	48	1.7	2.5	5.1	20.2	3.8
Normal drumhead reflexes	Triangular spot or point in or near the umbo	466	360	128	30	984	85.5	76.4	72.3	33.7	76.8
	Sulcus reflex covered by the anterior lower wall of the ear canal	135	114	39	11	299	24.8	24.2	22.0	12.4	23.3
Pathological state of the drumhead reflexes	Normal reflex absent	15	20	8	6	49	2.8	4.2	4.5	6.7	3.8
	Normal reflex far removed from the umbo toward the periphery	10	22	15	15	62	1.8	4.7	8.5	16.9	4.8
	Macular reflex *above* the short process	3	4	1	2	10	0.6	0.8	0.6	2.2	0.8
	Punctiform, linear, or more expanded reflex *behind* the short process	15	22	7	7	51	2.8	4.7	4.0	7.8	4.0
Color anomalies of the drumhead	Diffuse reddening or extravasation of blood	2	2	2	2	8	0.4	0.4	1.1	2.2	0.6
	Serum perceptible in the drum cavity	1		3		4	0.2		1.7		0.3
	Diffuse opacity	4	13	6		23	0.8	2.8	3.4		1.8
	Circumscribed opacities	59	68	30	13	170	10.8	14.4	16.9	14.6	13.3
	Calcifications	8	6	3	3	20	1.5	1.3	1.7	3.4	1.6
	Posterior streak of opacity	6	12	9	3	30	1.1	2.5	5.1	3.4	2.3
Form anomalies of the drumhead	Posterior fold	10	23	19	11	63	1.8	4.9	10.7	12.4	4.9
	Manubrium mallei widened, or short process projecting	6	15	8	8	37	1.1	3.2	4.5	9.0	3.9
	Atrophy	4	9	4	4	21	0.8	1.9	2.3	4.5	1.6
	Cicatrix	1	9	5	5	20	0.2	1.9	2.8	5.6	1.6

TABLE XV.—*Continued*.

PROTESTANT SCHOOL II.

Boys and Girls.

Hearing distance for whispered speech.		Number of auditory organs.					In percentages of each column.				
		Above 16 Metre.	16–8 Metre.	8–4 Metre.	4–0 Metre.	Total.	Above 16 Metre.	16–8 Metre.	8–4 Metre.	4–0 Metre.	Total.
Perforation of the drumhead	With otorrhœa		1	1	6	8		0.2	0.6	6.7	0.6
	Without otorrhœa		1	2	3	6		0.2	1.1	3.4	0.5
	Nasal speech	3	2	8	13	26	0.6	0.4	4.5	14.6	2.0
Former ear affections	Former discharge	9	25	25	32	91	1.7	5.3	14.1	36.0	7.1
	" impaired hearing	13	29	15	28	85	2.4	6.2	8.5	31.5	6.6
	" tinnitus	11	12	7	7	37	2.0	2.5	4.0	7.8	2.9
	" earache	26	37	12	21	96	4.8	7.9	6.8	23.6	7.5
Other history	Scarlatina	120	134	50	30	334	22.0	28.0	28.2	33.7	26.1
	Morbilli	308	253	91	45	697	54.7	53.7	51.4	50.6	54.4
	Rubeola	86	78	30	28	222	15.8	16.6	16.9	31.5	17.3
	Diphtheria	131	110	31	20	292	24.0	23.4	17.5	22.5	22.8
	Meningitis	7	6	1		14	1.3	1.3	0.6		1.1
	Trauma										
	Heredity	66	49	29	14	158	12.1	10.4	16.4	15.7	12.3
	Not examined with speculum on account of disease, etc.	21	27	9	3	60					

TABLE XVI.

HOLLAND'S INSTITUTE.

Hearing distance for whispered speech.		Number of auditory organs.		Total.	In percentages of each column.		Total.
		Above 8 Metre.	Below 8 Metre.		Above 8 Metre.	Below 8 Metre.	
Total auditory organs perceiving at the distance stated		192	30	222	100	100	100
Cerumen	*a.* Hindering examination	10	3	13	5.2	10.0	5.9
	b. Apparently occluding	2	2	4	1.0	6.7	1.8
Normal drumhead reflexes.	Normal reflex present	185	19	204	96.4	63.3	91.9
	Sulcus reflex covered by the anterior lower wall of the ear canal	140	17	157	72.9	56.7	70.7
Pathological state of the drumhead reflexes	Normal reflex absent		3	3		10.0	1.4
	Normal reflex far removed from the umbo toward the periphery	1	6	7	0.5	20.0	3.2
	Macular reflex *above* the short process	6		6	3.1		2.7
	Punctiform, linear, or more expanded reflex *behind* the short process	4	1	5	2.1	3.3	2.3
Color anomalies of the drumhead	Diffuse reddening	1	1	2	0.5	3.3	0.9
	Diffuse opacity	8	5	13	4.2	16.7	5.9
	Circumscribed opacities	29	3	32	15.1	10.0	14.5
	Calcifications	2		2	1.0		0.9
	Posterior streak of opacity	8	3	11	4.2	10.0	5.0
Form anomalies of the drumhead	Posterior fold	14	9	23	7.3	30.0	10.4
	Manubrium mallei widened or short process projecting	5	2	7	2.6	6.7	3.2
	Atrophy		1	1		3.3	0.5
	Cicatrix	2	1	3	1.0	3.3	1.4
Perforation of the drumhead	With otorrhœa						
	Without otorrhœa		1	1		3.3	0.5

TABLE XVI.—*Continued.*

HOLLAND'S INSTITUTE.

Hearing distance for whispered speech.		Number of auditory organs.		Total.	In percentages of each column.		Total.
		Above 8 Metre.	Below 8 Metre.		Above 8 Metre.	Below 8 Metre.	
Pharyngeal affections	Hypertrophied tonsils	33	5	38	17.2	16.7	17.1
	Pharyngitis diffusa	38	6	44	19.8	20.0	19.8
	Pharyngitis granulosa	12		12	6.3		5.4
	Lateral tumors	27	3	30	14.1	10.0	13.5
	Nasal speech	1	5	6	0.5	16.7	2.7
Former ear affections	Former discharge	7	6	13	3.6	20.0	5.9
	Former impaired hearing	7	4	11	3.6	13.3	5.0
	Former tinnitus	2	2	4	1.0	6.7	1.8
	Former earache	1	1	2	0.5	3.3	0.9
Other history	Scarlatina	64	8	72	33.3	26.7	32.4
	Morbilli	108	22	130	56.3	73.3	58.6
	Rubeola	41	3	44	21.4	10.0	19.8
	Diphtheria	53	5	58	27.6	16.7	26.1
	Meningitis	5	1	6	2.6	3.3	2.7
	Trauma	1	4	5	0.5	13.3	2.3
	Heredity	38	10	48	48.8	33.3	21.6

TABLE XVII.

TOTAL NUMBER OF BOYS FROM THE TWO PUBLIC SCHOOLS.

Hearing distance for whispered speech.		Number of auditory organs.				Total.	In percentages of each column.				Total.
		Above 16 Metre.	16–8 Metre.	8–4 Metre.	4–0 Metre.		Above 16 Metre.	16–8 Metre.	8–4 Metre.	4–0 Metre.	
Total auditory organs perceiving at the above distances in the two schools		808	509	199	130	1646	100	100	100	100	100
Cerumen	*a* Hindering examination	73	58	12	11	154	9.0	11.4	6.0	8.5	9.4
	b Apparently occluding	5	15	2	21	43	0.6	2.9	1.0	16.2	2.6
Normal drumhead reflexes	Triangular spot or point in or near the umbo	699	388	133	48	1268	86.5	76.2	66.8	36.9	77.0
	Sulcus reflex covered by the anterior lower wall of the ear canal	237	134	55	17	443	28.1	26.3	27.6	13.1	26.9
Pathological state of the drumhead reflexes	Normal reflex absent	27	33	18	14	92	3.3	6.5	9.0	10.8	5.6
	Normal reflex far removed from the umbo toward the periphery	18	17	20	15	70	2.2	3.3	10.1	11.5	4.3
	Macular reflex *above* the short process	7	8	2	2	19	0.9	1.6	1.0	1.5	1.1
	Punctiform, linear, or more expanded reflex *behind* the short process,	11	24	11	9	55	1.4	4.7	5.5	6.9	3.3
Color anamolies of the drumhead	Diffuse reddening or extravasation of blood	2	1	1	3	7	0.2	0.2	0.5	2.3	0.4
	Serum perceptible in the drum cavity			3	2	5			1.5	1.5	0.3
	Diffuse opacity	10	12	10	2	34	1.2	2.4	5.0	1.5	2.1
	Circumscribed opacities	80	65	30	15	190	9.9	12.8	15.1	11.5	11.5
	Calcifications	9	3	6	4	22	1.1	0.6	3.0	3.1	1.3
	Posterior streak of opacity	48	28	14	5	95	5.9	5.5	7.0	3.8	5.8
Form anomalies of the drumhead	Posterior fold	37	49	33	30	149	4.6	9.6	16.5	23.1	9.1
	Manubrium mallei widened or short process projecting	6	18	10	6	40	0.7	3.5	5.0	4.6	2.4
	Atrophy	2	6	6	3	17	0.2	1.2	3.0	2.3	1.0
	Cicatrix	7	9	7	4	27	0.9	1.8	3.5	3.1	1.6

TABLE XVII.—*Continued.*

TOTAL NUMBER OF BOYS FROM THE TWO PUBLIC SCHOOLS.

Hearing distance for whispered speech.		Number of auditory organs.					In percentages of each column.				
		Above 16 Metre.	16–8 Metre.	8–4 Metre.	4–0 Metre.	Total.	Above 16 Metre.	16–8 Metre.	8–4 Metre.	4–0 Metre.	Total.
Perforation of the drumhead	With otorrhœa			1	14	15	0.4	0.8	0.5	10.8	0.9
	Without otorrhœa	3	4	6	7	20	0.1	0.8	3.0	5.4	1.3
	Nasal speech	1	4	11	12	28	0.1	0.8	5.5	9.2	1.7
Former ear affections	Former discharge	38	34	34	42	148	4.7	6.7	17.1	32.3	9.0
	Former impaired hearing	19	34	16	31	100	2.4	6.7	8.0	23.8	6.1
	Former tinnitus	8	6	9	7	30	1.0	2.2	4.5	5.4	1.8
	Former earache	50	28	16	21	115	6.2	5.5	8.0	16.2	7.0
Other history	Scarlatina	166	126	43	37	372	20.5	24.8	21.6	28.5	22.6
	Morbilli	401	262	93	61	817	49.6	51.5	46.7	46.9	49.6
	Rubeola	147	103	34	26	310	18.1	20.2	17.1	20.0	18.8
	Diphtheria	167	119	31	41	358	20.7	23.4	15.6	31.5	21.8
	Meningitis	24	14			38	3.0	2.8			2.3
	Trauma			2		2			1.0		0.1
	Heredity	83	58	25	19	185	10.3	11.4	12.6	14.6	11.2
	Not examined with speculum on account of disease, etc.	23	30	13	6	72					

TABLE XVIII.

Total Number of Girls from the Two Public Schools.

Hearing distance for whispered speech.		Number of auditory organs.				Total.	In percentages of each column.				Total.
		Above 16 Metre.	16–8 Metre.	8–4 Metre.	4–0 Metre.		Above 16 Metre.	16–8 Metre.	8–4 Metre.	4–0 Metre.	
Total auditory organs among the girls perceiving at the above distances		851	680	271	166	1968	100	100	100	100	100
Cerumen	*a.* Hindering examination	79	69	21	12	181	9.3	10.1	7.7	7.2	9.2
	b. Apparently occluding	12	14	14	11	51	1.4	2.1	5.2	6.6	2.6
Normal drumhead reflexes	Triangular reflex or point in or near the umbo	735	556	191	65	1547	85.2	81.8	70.5	39.2	78.6
	Sulcus reflex covered by the anterior lower wall of the ear canal	300	231	90	43	664	35.3	34.0	33.2	25.9	33.7
Pathological state of the drumhead reflexes	Normal reflex absent	8	24	10	13	55	0.9	3.5	3.7	7.8	2.8
	Normal reflex far removed from the umbo toward the periphery	14	31	29	36	110	1.6	4.6	10.7	21.1	5.6
	Macular reflex *above* the short process	4	4	3	3	14	0.5	0.6	1.1	1.8	0.7
	Punctiform, linear, or more expanded reflex *behind* the short process	22	24	13	10	69	2.6	3.5	4.8	6.0	3.5
Color anomalies of the drumhead	Diffuse reddening or extravasation of blood	2	3	2	1	8	0.2	0.4	0.7	0.6	0.4
	Serum perceptible in the drum cavity	1	1	2	1	5	0.1	0.2	0.7	0.6	0.3
	Diffuse opacity	9	15	10	10	44	1.0	2.2	3.7	6.0	2.2
	Circumscribed opacities	93	107	49	18	267	10.9	15.7	18.1	10.8	13.6
	Calcifications	13	9	5	6	33	1.5	1.3	1.8	3.6	1.7
	Posterior streak of opacity	14	26	16	9	65	1.6	3.8	5.9	5.4	3.3
Form anomalies of the drumhead	Posterior fold	23	32	34	31	120	2.7	4 7	12.5	18.7	6.1
	Manubrium mallei widened or short process projecting	9	14	10	9	42	1.0	2.1	3.7	5.4	2.1
	Atrophy	9	11	6	6	32	1.0	1.6	2.2	3.6	1.6
	Cicatrix	4	16	12	11	43	0.5	2.4	4.4	6.6	2.2

TABLE XVIII.—*Continued.*

TOTAL NUMBER OF GIRLS FROM THE TWO PUBLIC SCHOOLS.

Hearing distance for whispered speech.		Number of auditory organs.				Total.	In percentages of each column.				Total.
		Above 16 Metre.	16–8 Metre.	8–4 Metre.	4–0 Metre.		Above 16 Metre.	16–8 Metre.	8–4 Metre.	4–0 Metre.	
Perforation of the drumhead	With otorrhœa		1	2	17	20		0.2	0.7	10.2	1.0
	Without ottorrhœa	2	3	3	7	15	0.2	0.4	1.1	4.2	0.8
	Nasal speech	2	4	6	14	26	0.2	0.6	2.2	8.4	1.3
Former ear affections	Former discharge	26	49	41	54	170	3.1	7.2	15.1	32.5	8.6
	Former impaired hearing	14	28	23	52	117	1.6	4.1	8.5	31.3	5.9
	Former tinnitus	27	25	15	12	79	3.2	3.7	5.5	7.2	4.0
	Former earache	24	68	22	24	138	2.8	10.0	8.1	14.5	7.0
Other history	Scarlatina	194	167	74	51	486	22.8	24.6	27.3	30.7	24.7
	Morbilli	462	366	163	89	1080	54.3	53.8	60.0	53.6	54.9
	Rubeola	193	152	52	41	438	22.7	22.4	19.2	24.7	22.3
	Diphtheria	199	157	65	41	462	23.4	23.1	24.0	24.7	23.5
	Meningitis	6	9	6	3	24	0.7	1.3	2.2	1.8	1.2
	Trauma										
	Heredity	83	53	31	26	193	9.8	7.8	11.4	15.7	9.8
	Not examined with speculum on account of disease, etc.	22	15	6	1	44					

TABLE XIX.

TOTAL NUMBER OF BOYS AND GIRLS FROM THE TWO PUBLIC SCHOOLS.

Hearing distance for whispered speech.		Number of auditory organs.				Total.	In percentages of each column.				Total.
		Above 16 Metre.	16–8 Metre.	8–4 Metre.	4–0 Metre.		Above 16 Metre.	16–8 Metre.	8–4 Metre.	4–0 Metre.	
Total auditory organs in both schools perceiving at the above distances		1659	1189	470	296	3614	100	100	100	100	100
Cerumen.	*a.* Hindering examination	152	127	33	23	335	9.16	10.68	7.02	7.77	9.27
	b. Apparently occluding	17	29	16	32	94	1.02	2.44	3.40	10.81	2.61
Normal drumhead reflexes	Triangular spot or point in or near the umbo	1437	944	324	113	2815	86.44	79.39	68.94	38.18	77.89
	Sulcus reflex covered by the anterior lower wall of the ear canal	537	365	145	60	1107	32.37	30.70	30.85	20.27	30.63
Pathological state of the drumhead reflexes	Normal reflex absent	35	57	28	27	147	2.11	4.79	5.96	9.12	4.07
	Normal reflex far removed from the umbo toward the periphery	32	48	49	51	180	1.93	4.04	10.43	17.23	4.98
	Macular reflex *above* the short process	11	12	5	5	33	0.66	1.01	1.06	1.69	0.91
	Punctiform, linear, or more expanded reflex *behind* the short process	33	48	24	19	124	1.99	4.04	5.11	6.42	3.43
Color anomalies of the dumhead	Diffuse reddening or extravasation of blood	4	4	3	4	15	0.24	0.34	0.64	1.35	0.42
	Serum perceptible in the drum cavity	1	1	5	3	10	0.06	0.08	1.66	1.01	0.28
	Diffuse opacity	19	27	20	12	78	1.15	2.27	4.26	4.05	2.10
	Circumscribed opacities	173	172	79	33	457	10.43	14.47	16.81	11.15	12.65
	Calcifications	22	12	11	10	55	1.33	1.01	2.34	3.38	1.52
	Posterior streak of opacity	62	54	30	14	160	3.74	4.54	6.38	4.73	4.43
Form anomalies of the drumhead	Posterior fold	60	81	67	61	269	3.62	6.81	14.26	20.61	7.42
	Manubrium mallei widened or short process projecting	15	32	20	15	82	0.90	2.69	4.26	5.07	2.27
	Atrophy	11	17	12	9	49	0.66	1.43	2.55	3.04	1.36
	Cicatrix	11	25	19	15	70	0.66	2.10	4.04	5.07	1.94

TABLE XIX.—*Continued.*

TOTAL NUMBER OF BOYS AND GIRLS FROM THE TWO PUBLIC SCHOOLS.

Hearing distance for whispered speech.		Number of auditory organs.				Total.	In percentages of each column.				Total.
		Above 16 Metre.	16–8 Metre.	8–4 Metre.	4–0 Metre.		Above 16 Metre.	16–8 Metre.	8–4 Metre.	4–0 Metre.	
Perforation of the drumhead	With otorrhœa		1	3	31	35		0.08	0.64	10.37	0.97
	Without otorrhœa	5	7	9	14	35	0.30	0.59	1.91	4.73	0.97
	Nasal speech	3	8	17	26	54	0.18	0.67	3.62	8.78	1.49
Former ear affections	Former discharge	64	83	75	96	318	3.86	6.98	15.96	32.43	8.80
	Former impaired hearing	33	62	39	83	217	1.90	5.21	8.30	28.04	6.00
	Former tinnitus	35	31	24	19	109	2.11	2.61	5.11	6.42	3.02
	Former earache	74	96	38	45	253	4.46	8.07	8.09	15.20	7.00
Other history	Scarlatina	360	293	117	88	858	21.70	24.64	24.89	29.73	23.74
	Morbilli	363	628	256	150	1897	51.02	52.82	54.74	50.68	52.49
	Rubeola	340	255	86	67	748	20.49	21.45	18.30	22.64	20.70
	Diphtheria	366	276	96	82	820	22.06	23.21	20.42	27.70	22.69
	Meningitis	30	23	6	3	62	1.81	1.93	1.28	1.01	1.72
	Trauma			2		2			0.43		0.06
	Heridity	166	111	56	45	378	10.00	9.34	11.91	15.20	10.46
	Not examined with speculum on account of disease, etc.	45	45	19	7	116					

Inasmuch as it became improbable from these figures that simple inspection from the mouth could give us sufficient data regarding the etiological connection of ear-diseases with pharyngeal affections, and as a thorough rhinoscopical examination was not feasible, I have abstained in the other two schools from a general examination of the pharyngeal space, and have merely noted the continual presence of nasal speech.

It would be quite erroneous if we were to expect that the deviations from the normal recorded in the table would be found *only* with more or less decreased hearing distance. On the contrary, it is well known that very great alterations may be present on the drumhead without any impairment of hearing being demonstrable. How frequent are the most various pathological conditions on the drumhead in the presence of normal hearing distance is shown by the figures in the following tables; they possess all the greater value, as the large rooms at my disposal permitted a more thorough test of the function than is possible in the physician's office.

It is a matter of great interest to ascertain from these figures how, in the face of many injurious influences, and despite many pathological alterations in its conducting apparatus actually present, our special-sense organ can maintain its full capacity; how its function is comparatively independent of a number of disturbances affecting the ear with special frequency.

As regards the significance of the several recorded alterations for the *diagnosis*, I should like first to call attention to the accidental occurrences which are of no importance for the function of the auditory organ, in order to show in connection therewith how, under these circumstances, the percentages gained stand in relation to the tabular arrangement chosen by us. For instance, if we consider the accumulation of cerumen, which only in part interfered with the examination, but left a certain lumen to the auditory canal, so that the hearing remained uninfluenced, the percentages in the whole five columns are nearly equal. This is the case also with the figures for the sulcus reflex,

and for a part of the preceding general diseases—rubeola, meningitis, and measles. Those with impaired hearing are here also frequently represented in slightly smaller percentages than those with normal hearing. The reverse is the case with the percentages of all those symptoms which clinical experience has taught us to be more or less characteristic of diseases of the auditory organ. The more rapidly and regularly the percentage numbers of a symptom increase from the column of the normal to the columns of successively worse hearing, and the more uniformly these relations are encountered in the tabulation of *all* the children, as well as in the *several* schools and the two *sexes*, the more essential for our diagnosis may we regard the symptom in question; nay, we are justified in designating the relations found in this manner as actually the numerical expression of the diagnostic significance of the several symptoms.

In the same way could be determined also the etiological importance for ear affections of the other local and general diseases taken into consideration, and, finally, the tables give us some information as to the influence of heredity on diseases of the ear.

In order to facilitate matters, I shall in the following pages place together, in the discussion of every single symptom or etiological factor, the series of numbers found in the three schools and the two sexes with the total figures of table XIX., so as to show in how far the relations prove constant even with a limited amount of material.

(*To be concluded.*)

REPORT ON THE PROGRESS OF OTOLOGY IN THE SECOND HALF OF THE YEAR 1884.

Translation by Dr. Jefferson Bettman, New York, Assistant Surgeon to the N. Y. Ophthalmic and Aural Institute.

I.—NORMAL AND PATHOLOGICAL ANATOMY OF THE ORGAN OF HEARING.

By Dr. H. STEINBRÜGGE,

LECTURER ON OTOLOGY AT THE UNIVERSITY OF GIESSEN.

1. Prof. E. Zuckerkandl. Contributions to the anatomy of the organ of hearing. (*a*) Ossification of a circumscribed portion of the lateral cartilaginous wall of the Eustachian tube. (*b*) Reticular cartilage at the hamulus pterygoideus.

2. Prof. Paul Albrecht. On the morphological importance of the Eustachian tube, the origin of the palatine, mandibular, and hyoid arches in the Vertebrates, followed by a demonstration that the "symplectico-hypomandibular" is morphologically independent of the hyoid arch. A communication to the Society of Pathological Anatomy at Brussels, May 11, 1884. Thirteen illustrations elucidate the text.

3. Prof. E. Zuckerkandl. The erectile tissue of the nasal mucous membrane, and its relation to the respiratory fissure. *Wiener med. Wochenschr.*, No. 38, 1884.

4. Prof. Philipp Stöhr. Tonsils and sebaceous follicles. *Virchow's Archiv*, Bd. xcvii., p. 211.

5. Dr. Gustav Bickel, of Wiesbaden. The extent and relation of lymphatic tissue in the pharyngeal region. *Virchow's Archiv*, Bd. xcvii., p. 340.

6. Dr. Alfred Nobiling, of Munich. Pathological ob-

servations in cases of death due to asphyxia in the new-born, and their medico-legal bearing. *Bayrisches ärztl. Intelligenzblatt*, 1884.

1. ZUCKERKANDL (1, *a*) found a small piece of bone, the size of a hemp-seed, in the anterior wall of the Eustachian tube of a man, the pharyngeal orifice being in other respects quite normal. The spicula was firmly adherent to the mucous membrane, and the author regards it, similar to analogous cases already published by Moos, as a circumscribed ossification of the cartilage. Under peculiar circumstances this may have caused some difficulty in attempted catheterization of the Eustachian tube. The presence of accessory cartilaginous plates in the floor of the tube, in the pharyngeal prominence, in the lateral walls, and in the ligaments connecting the cartilaginous portion of the tube with the vault of the pharynx, is so frequent an occurrence as to be considered a normal condition. They have but little practical bearing as long as ossification has not set in.

(1, *b*) The point of the hamulus pterygoideus consists of a fibro-cartilaginous process, which constitutes $\frac{1}{4}$ to $\frac{1}{3}$ of the entire length of the hamulus. Cross-sections of the process reveal a dense, fibrous tissue at the periphery, more loosely bound and enclosing isolated cartilage cells toward the centre.

Numerous cartilage cells embedded in a striated basis-substance, occupy the yellow-stained centre. The latter, after treatment with a ten-per-cent. potash solution, was found to consist of elastic tissue. The hamular process is accordingly composed at its periphery of fibrous tissue and fibro-cartilage; the centre, of reticulated cartilage. As yet the physiological function of the process is unknown.

2. The author alludes to his deductions, already published, that the maxillary joint of mammals is homologous to that of the lower gnathostomes. He, furthermore, concludes, that the ossicles of the ear in mammals represent the columella of birds and reptiles; the latter again, the so-called symplectico-hypomandibulary arch of fishes. According to ALBRECHT'S researches, the last mentioned is genetically independent of the hyoid, it being a part of the dorsal portion of the mandibulary arch.

3. The ethmoid bone is much more developed in carnivora than in the herbivora, although the length of the turbinated bones is greater, and the presence of the erectile tissue acts compensatorily

for this want of development in the latter. In human beings this condition is very marked. Here not alone the anterior and posterior extremities of the turbinated bones, but also the medial surface and the free border of the middle turbinated bone, are covered with erectile tissue. The shape of the turbinated bones increases the area of mucous membrane, and the overlying cavernous tissue reduces the nasal fossa to a fissure the size of which is dependent on the more or less turgid state of the erectile tissue. An abnormal width of the respiratory fissure, a condition existing in ozæna, favors pathological influences in reducing the area of mucous membrane, and in permitting the entrance of too great a volume of air in nasal respiration. That part of the mucous membrane overlying the erectile tissue is thick, and contains numerous striped muscle-fibres. The cavernous tissue in its superficial layer is composed of a reticulum of fine venous channels, which becomes more extensive in the deeper layer. A turgescence of these tissues can produce sudden changes in the width of the respiratory fissure. The periosteal portion of the mucous membrane contains the efferent vessels. The arteries generate three capillary systems: a periosteal, a glandular, and a superficial net. In closing remarks, the author dwells upon the reflex neuroses arising from the turgid state of the erectile tissue, a condition first thoroughly described by Hack.

4. The mucous membrane of the mouth and pharynx, covered with pavement-epithelium, contains adenoid tissue in various parts of its folds and recesses. Masses of leucocytes, which abound in this adenoid tissue, migrate through the layer of epithelium and appear on the surface of the mucous membrane as mucous and salivary corpuscles. This is no pathological, but a normal process. The leucocytes migrate through the cement substance, slightly pushing the epithelia aside. In the passage between the cells the protoplasm of these amœboid corpuscles becomes elongated, the nucleus but rarely changing its shape. The author has observed that, within and on the surface of the epithelial coat, multiple division of the nuclei, as if due to some general and sudden cause, takes place. The leucocytes always seek the shortest route in their migrations. The author has observed these changes in the tonsils of cats, rabbits, porcupines; again, in cattle, sheep, pigs, dogs, moles; and lastly, in the follicles of the tongue and tonsils of healthy human beings.

He found these corpuscles heaped up in masses, surrounding the mouths of the mucous follicles in the case of a child three months old. In adults, the epithelia lining the acini are filled with leucocytes, whilst but few are found in the epithelia covering the base of the tongue. Migration does not take place equally in all parts, as certain epithelial tracts in the fissures of the tonsil and on its surface contained more leucocytes than were found in other portions of the tissue. The leucocytes were never observed to have penetrated into the interior of the epithelial cells. In all probability in more advanced stages, this extensive subepithelial infiltration produces a destruction and subsequent regeneration of the epithelial layer. Migration of these cells begins at birth, and if not influenced by disease continues during life. In closing, the author dwells upon the practical signification of this process; the interepithelial spaces produced by the passage of leucocytes may serve as points of entrance for infectious micro-organisms.

5. The author attempts to define the extent of adenoid tissue in the pharyngeal region, and to decide to which structures the term "tonsils" in the true meaning is applicable. His conception of a tonsil is as follows: (*a*) A circumscribed shape; (*b*) a crowded, diffuse infiltration of lymphoid cells containing agglomerations of small lymphatic follicles; (*c*) crypts; (*d*) the extension of adenoid tissue close to the epithelial layer. The author leaves undecided whether or not acinous glands are necessary in the definition of a tonsil. Excluding the faucial tonsils, this term ought accordingly merely be applied to the "pharyngeal tonsil." The follicles surrounding the opening of the tube, and situated at the root of the tongue, represent structurally a transitorial change into a simple conglomeration of adenoid tissue. He reviews the literature on this subject from the time of Vesalius up to modern date, and appends the results of twenty-four autopsies, these embracing subjects of both sexes and at various ages.

In dwelling upon the extent of lymphatic tissue, the author confirms the presence of the "pharyngeal adenoid zone" described by Waldeyer. This, including the pharyngeal tonsil, extends laterally to the tissue surrounding the pharyngeal orifice of the tube, involving the posterior border of the velum, continues posterior to the palato-pharyngeal fold, to the faucial tonsil, and crosses the base of the tongue to the other side. The personal researches of the author include the study of the adenoid tissue surrounding this zone, and the development of the various

varieties of tonsils. During the fœtal period, and in the first year after birth, the pharyngeal tonsil is represented by a pouching in of the mucous membrane. Later on in life, a pad-like prominence develops from the bottom of this pouch. The development of the follicles at the root of the tongue takes place inversely ; their presence being primarily represented by ridges which subsequently disappear, leaving distinct pouches. The presence of lymphatic tissue in the pharynx, around the openings of the tubes, is at first indicated by a series of fine longitudinal folds ; a condition also noticeable on the anterior and posterior surfaces of the soft palate. These folds generally disappear during the first year after birth. In individual cases they remain in the faucial tonsils, and in the collection of adenoid tissue surrounding the tubal orifices. These folds are profusely infiltrated with lymphatic elements.

Besides the large lymphatic zone, the author demonstrates the presence of a second and smaller one, composed of the faucial tonsils, of the follicles at the base of the tongue, and of the adenoid tissue in the soft palate. Extending from this circle, the adenoid tissue radiates, in varying amount and frequency, along the floor of the mouth, over the posterior surface of the velum into the nasal fossæ. In the latter location it extends along the lower and middle meatuses to the anterior extremity of the inferior and middle turbinated bones. Occasionally, involving the epiglottis, it extends into the larynx. The author also alludes (*vide* this Review 4) to the susceptibility of these structures to the absorption of infectious material. This condition is probably regulated by the varying arrangement of the lymphatic structures in different individuals.

6. Nobiling studied the pathological changes following asphyxia in the bodies of 173 new-born infants, at, or almost at, full term ; further those of 138 decomposed fœtuses, varying in the period of development from the seventh to the ninth month ; and those of 142 fœtuses from the fourth to the end of the seventh month in age. Many of the latter had lived some time after premature delivery. In reviewing, merely those changes involving the ear and the naso-pharyngeal space are considered. The auricle, external meatus, and the external layer of the membrane present no lesions. Hemorrhages are always traumatic in origin. The vessels of the tympanic cavity and the lining of the tube are always highly engorged, the mucous membrane presenting punctate hemorrhages. The latter may induce a slight elevation or thickening of the

membrane. At times hemorrhages take place into the middle ear. The appearance of both tympanic cavities varies considerably in individual cases. If asphyxia has taken place in a fluid medium, some of it will be found in the middle ear. The labyrinthian fluid is often reddish in tinge, due to the presence of blood-corpuscles. The inner surface of the plate of the stapes is markedly injected, and at times the fluid contents of the cochlea are also tinged with blood. The body of the tensor-tympani muscle is striated by fine, linear, bloody extravasations. This, excluding a similar condition in the ocular muscles, is found in no other muscles of the body. The nasal mucous membrane is intensely congested, that part covering the turbinated bones much thickened and the seat of mucous extravasations. Extensive ecchymoses are found in the mucous lining of the tubes, choanæ, and pharynx. Hemorrhages often take place into the naso-pharynx. Œdematous thickening of the nasal mucous membrane has also been observed. In aspiration the blood may be sucked into the alveoli of the lung.

II.—PATHOLOGY AND THERAPEUTICS OF THE EAR.

By A. HARTMANN, of Berlin.

GENERAL.

1. Dr. Bezold, of Munich. Report of cases of ear trouble treated from 1881 to 1883 inclusively. *Arch. f. Ohrenheilk.*, Bd. xxi., p. 221.

2. Bezold. Report of ear cases treated clinically from 1881, including 1883. *Aerztl. Intelligenzbl.*, No. 49., 1884.

3. Dr. Wagenhaeuser, of Tübingen. Aural report of the Policlinic at Tübingen of cases treated from the 1st of April, 1883, to the 1st of April, 1884. *Arch. f. Ohrenheilk.*, Bd., xxi., p. 267.

4. Dr. Jacobson, of Berlin. Report of ear cases treated in the University clinic at Berlin from April 1, 1881, to April 1, 1884. *Ibid.*, p. 276.

5. Dr. Bürkner, of Göttingen. Report of ear cases treated in the Policlinic at Göttingen during the year 1883. *Arch. f. Ohrenheilk.*, Bd., xxi., p. 169.

6. Dr. Kirchner, of Munich. Aural diseases in diabetes

mellitus. *Monatsschr. f. Ohrenheilk.*, No. 12, 1884 ; compare with our report of the Congress at Basel, p. 159.

7. A. DREYFUSS. Recent observations relating to mumps. *Gazette hebdom. de méd. et de chirurg.*, No. 30, 1884.

8. Dr. AUGUST LUCAE, of Berlin. The origin and treatment of subjective tinnitus aurium. Verlag von Otto Enslin, 1884.

9. Dr. SAMUEL SEXTON, of New York. Hallucinations of hearing and faulty audition in musicians and singers, occasioned by autophony in diseases of the ear. *Revue mens. de laryng., d'otol.*, etc.. No. 11, 1884.

10. Dr. F. ROHRER, of Zurich. A case of sudden deafness after measles. *Correspondenzbl. für Schweiz. Aerzte*, 1884.

11. Prof. ZAUFAL. Use of cocaine, in otology. *Prager Med. Wochenschr.*, No. 47, 1884.

12. Drs. E. J. MOURE and J. BARATOUX. The use of the chlorhydrate of cocaine as an anæsthetic of the pharyngeal, laryngeal, and nasal mucous membranes, and in the treatment of diseases of these organs and of the ear. *Revue mens. de laryng., d'otol.*, etc., No. 12, 1884.

13. LEARTUS CONNER. Mumps as a cause of sudden deafness. *Amer. Jn'l Med. Sci.*, Oct., 1884.

14. G. F. HAWLEY. The effect of noise upon certain forms of deafness. *N. Y. Med. Record*, July 5, 1884.

15. Dr. S. SEXTON. A handy pocket-ear-cure.—*N. Y. Med. Record*, July 12th.

16. W. A. BARTLETT. Pain in the ears due to irritation in the jaws. *N. Y. Med. Record*, Oct. 4, 1884.

1. BEZOLD publishes a tabular report, with special reference to therapeutical results, of 2,569 ear cases treated in his private practice from 1881 to the end of 1883. A second report embraces 3,846 patients treated in both his private and clinical practice. On studying the reports, the small number of children affected by non-perforating chronic middle-ear affections is striking. The same condition exists in dysacusis, as yet not clearly defined, and attention is further directed to the bilateral appearance of this symptom. A review of the statistics demonstrates the relation of subjective tinnitus, vertigo, and heredity in chronic non-suppurative affections of the middle and inner ears. It is shown that

heredity is the dominating factor in those cases of deafness where pathological changes are assumed to have affected the labyrinthian fenestræ and to have produced an immobility of the contingent structures. In reference to sex and age, the determining cause of these affections must be sought for in conditions existing mainly in members of the male sex of more advanced ages.

Table IV. reviews the intensity and duration of the diseases affecting various parts of the ear due to scarlatina. In addition to this he compares the otorrhœæ occurring in scarlatina, diphtheria, and measles, and demonstrates that in both of the latter combinedly not one fourth the number of ear complications result as in scarlatina. Simple, acute, and subacute inflammations and chronic purulent conditions of the middle ear occurring in syphilis are attributed by the author to primary affections of the nose and the naso-pharynx. In closing, the author arranges all the cases of acute and subacute affections of the external and middle ears observed during the period 1881–1883, with special reference to the exact month of the time of the attack. According to this, thermometric and barometric changes seem to exert a decided influence on the course of so-called acute and subacute catarrhs of the middle ear,—a condition quite at variance to that induced in cases of acute suppurative affections. The deductions of the above lead to the inference that climatological influences either affect the course of middle-ear catarrhs differently from that in purulent conditions, or that the development of the latter is perfectly independent of these influences.

2. Bezold's second report relates to 1,277 ear cases treated in the Policlinic during the term 1881, to and including 1883. Of these, 328 were external ear troubles, 840 affections of the middle ear, and 94 diseases of the inner ear. Expressed in percentages, affections of the external ear composed 26.0, of the middle ear 66.6, and of the inner ear but 7.4. Comparisons with similar statistics of private cases induce the author to regard this relative percentage of diseases affecting various parts of the ear as a standard. This proportion is not influenced by the grade of the class of patients, by seasons, or by atmospheric and telluric conditions. Aspergillus growths in the external meatus occur less frequently in clinical than in practice of a higher social plane. However, eczema of the auricle and the auditory meatus occurs more often, and cases of inspissated cerumen by far most frequently, in the former.

The ratio of cases of traumatic rupture of the membrane is double in clinical to that of private practice. The author's statistics also show that affections of the tube, especially those affecting children, are more numerous in private practice. The same condition exists relative to subacute catarrh of the middle ear, whilst contrarily, cases of acute middle-ear catarrh are more numerous in the clinic.

There is no variance in the relative number of cases of acute middle-ear catarrh and acute purulent inflammation either in private or clinical practice, but instances of chronic purulent otitis media occur more often in the clinic. Perforations of Shrapnell's membrane and cases of cholesteatoma of the middle ear are observed more often in private practice. Regarding diseases of the inner ear, the author finds that, comparatively, cases of unilateral deafness, and especially impaired hearing and deafness, due to traumatism, occur relatively more often in clinical practice. Contrarily, cases of subjective tinnitus without any impairment of hearing and of nervous deafness seem to prevail in private clientèle. The author has noticed several cases of acute otitis media purulenta arise during the course of erysipelas, and he describes *in extenso* the clinical features of one of these cases.

One case of acute suppuration of the middle ear, originating during an attack of abdominal typhoid, was also observed. Judging from the history of this case, it is seen that even mild forms of suppuration occurring in typhoid may, in certain conditions, exert some influence upon the general constitution. Two cases of purulent middle-ear disease ended fatally. In two cases, sequestra were removed. The one, occurring in a child one and a quarter year old, of inherited syphilitic taint, included the whole unchanged tympanic ring. In the second case, that of an infant fourteen months old, the extracted sequestrum was composed of the greater part of the cochlea and its surroundings.

3. During the term April 1, 1883, to April 1, 1884, 391 ear patients were treated in the Policlinic at Tübingen. One case of hemorrhagic otitis externa presents interesting features, as the patient became delirious, and suffered from hallucinations. This case goes to show that severe inflammation of the external meatus may produce cerebral symptoms without any direct involvement of the middle ear.

Amongst the cases of parasitic growths, the author observed and describes a new form of aspergillus, the mucor coymbifer.

This form of aspergillus is characterized by the umbelated arrangement of the sporangia, by small, colorless, pear-shaped heads, by a brownish top-shaped columella, and by the minute, colorless, elongated spores.

4. In reviewing the 240 varieties of disease occurring during the first three years' existence of the aural department of the University clinic at Berlin, the author devotes special attention to those forms in which subcutaneous injections of muriate of pilocarpin had been instituted as a mode of treatment. These embraced thirty-five cases of disease of the sound-perceiving apparatus, in which it was expected that energetic stimulation of the sudoriferous and salivary glands would induce absorption of exudatious or non-organized inflammatory products in the inner ear. In twenty-four cases no appreciable improvement followed, five were slightly improved, whilst in but six a marked increase in the range of audition was observed. Although the general results were not very favorable, Jacobson advocates further trials of these pilocarpin injections, and recommends their use in those forms of deafness presenting no conclusive evidence of involvement of the acoustic nerve, and in which inflations and injections into the middle ear had been attended by little or no improvement. It is possible that more recent cases of the latter type may be considerably improved by this mode of treatment.

Thirty-one operations upon the mastoid process were attended by but one fatal result. In this isolated case, cerebral complications were already so pronounced at the time of operation as to render death inevitable. The remainder of the report is devoted to clinical notes, and in closing, the author encourages the use of several of the recent more popular medicinal agents. Chlorinated water is highly spoken of as an energetic disinfectant in preference to boracic acid. It not only produces a rapid decrease in the amount of secretion, but exerts a caustic effect on small granulations and polyps. In the removal of dessicated or cholesteatomatous matter, he advises syringing with equal parts of water and alcohol. The use of this mixture will prevent soaking and swelling of these masses.

5. Excluding 58, who had been discharged after one or more examinations, 812 ear patients were treated at the Policlinic, at Göttingen, during 1883. A case of hemorrhage into the tympanum, induced by a fit of coughing in a phthisical patient, is described in detail. Other cases of interest are, one of rupture

of the tympanic membrane, produced by a kiss on the ear, another of clonic spasms of the tensor-tympani muscle, occurring in a patient suffering from marked catarrh of the Eustachian tube. The author was able to corroborate the statements of a locomotive engineer, who experienced a loud cracking and at the same time a slight movement in the right ear every time he heard the steam-whistle. On producing a noise by scratching a pane of glass with a knife, these sounds became audible to the observer. The cases of three glass-blowers are of some interest, as all three suffered from similar subjective tinnitus, constant and singing in character, without presenting any visible lesion. In all three this symptom disappeared on abandoning its cause—their trade. The author attributes these subjective noises to a condensation of the air in the tympanic cavity, with subsequent increase of intra-labyrinthian pressure, and to a state of congestion induced by the retention of air in the forcible expirations. Basing his experience on fifty cases, the author highly recommends the use of sulphate of atropine as a very efficient anodyne in painful diseases of the ear, and inclines to the belief that it exerts a direct influence on the peripheric sensory nerves.

7. Dreyfuss adds two more cases, occurring in his own experience, to the thirteen cases described by Lemoine and Lannois, and the additional three published by Buck, of New York, of unilateral deafness following mumps. He shares the opinion that many cases of temporary deafness or impairment of hearing following mumps are overlooked by parents, and that probably many cases of unilateral deafness not attributable to any direct cause date their origin from a preceding attack of parotitis. According to him, aural troubles set in usually a few days after the onset of the main trouble; in both his cases, not till twelve days after recovery from a mild attack of mumps. Cases are recorded, however, where aural trouble preceded the attack of mumps by two to three days. The aural complications are generally ushered in by rushing, hissing tinnitus and more or less pain in the ear. Later on the train of Ménière's symptoms, such as vertigo, nausea, and vomiting set in. Convulsions or loss of consciousness have, however, never been noticed. In both the author's cases the aural disorder was merely preceded by a feeling of malaise and lassitude. Deafness develops very rapidly, in a few hours, never later than within two to three days, while the membrane, pharynx, and Eustachian tube are to all appearances perfectly

normal. The author does not share the opinion of Lemoine and Lannois, that deafness is always irremediable, as hearing power was almost entirely restored in one of his cases. Dreyfuss entertains views similar to those of Brunner, that the pathological changes consist in an exudation into the labyrinth, with subsequent atrophy—changes resembling those occurring in the testicle in attacks of mumps. He rejects the assumption as not being tenable, especially in those instances where aural complications arise prior to or after the general attack, that the process is an inflammatory extension from the parotid gland along the facial nerve or through the Glaserian fissure. Furthermore, the rapid development of the deafness would not favor this hypothesis.

The author thinks that we have to deal here with a localization (metastasis) of the morbid products independent of the usual limits of parotitis. Not only the lymphatic, salivary, and seminal glands, but also the organs of special sense are affected in parotitis. The disturbances in the auditory organ are analogous to those which have recently, from the same origin, been noticed in the visual organ—namely, conjunctivitis, amblyopia, and optic neuritis.

8. The publication of LUCÆ, treating of the relation of subjective tinnitus to external sounds and of the dependence of troubles of hearing on subjective tinnitus, tends to the conclusion, that the latter is more often induced, than hitherto recognized, by external sounds. Inversely, however, the author has frequently been able to check or ameliorate the tinnitus through the action of external sounds. In reference to the relation of impaired audition to the subjective tinnitus, the observer has noticed, that immediately after the cessation of the latter a marked improvement in hearing takes place.

To elucidate his views, the author has classified the various forms of tinnitus into two main divisions. The first division includes those forms of tinnitus, the intensity of which is increased by the action of external sounds; the second, in which a similar action produces a diminution. The first category usually embraces those cases in which the tinnitus is produced by repeated, prolonged exposure to sound, as in the case of musicians, amateurs, and artisans of various crafts. Means should be adopted to shield this class of patients from the action of external sounds. To enforce this, it is necessary to completely plug the affected ear, to evade exposure to the sounds producing the tinnitus, and,

analogous to the dark-room treatment adopted by oculists, to reside in a vicinity as free as possible from noises and sounds.

In those cases, also, where aural disturbances are attributable to a sudden violent concussion, and in which the tinnitus is not aggravated by external sounds, in connection with an existing impairment of hearing and great sensitiveness to certain sounds, a strict adherence to the above-mentioned régime will often produce improvement in hearing and amelioration of the tinnitus. Both the author and Urbantschitsch have made the observation, that in many cases of subjective tinnitus the application of a vibrating tuning-fork will frequently produce a marked temporary amelioration, occasionally an entire suspension, of the symptom. The author has utilized this observation in the treatment of those numerous cases, in which the subjective tinnitus is more or less marked by external sounds. Based upon the favorable results produced in a case of tinnitus of a high-pitched whistling character by the low rumbling of vehicles, he institutes a methodical treatment, using objective sounds opposite in pitch to that of the subjective tinnitus. Tinnitus, high in pitch, such as hissing or ringing, was treated by low tones (C_1, C); whilst inversely, low, rushing, and roaring tinnitus, by objective tones high in pitch (C^3, C^4). In many cases this treatment was followed by an immediate or gradual improvement ; the tinnitus generally persisting a brief period, in some instances, a few days, after the suspension of this mode of treatment. A surprising improvement in hearing power was at the same time noticeable in many of these favorable cases. The range of audition increased several metres and continued to improve for months, even after the treatment by sounds had been discontinued.

9. Sexton's publication treats of three cases of auditory hallucinations and faulty perception of musical tones and noises. Ménière's symptoms co-existed in the first two cases, whilst varying deafness, due to nasal catarrh, complicated the third case. Sexton restricts the clinical description of these cases to the subjective symptoms of the patients, without mentioning any physical conditions, especially those relating to the Eustachian tubes. The symptoms enumerated consisted of impaired hearing, faulty perception of vocal and instrumental tones, and auditory hallucinations. The third case was marked by deafness for ordinary tones and [1] "l'autophonie à tel point qu'il lui était impossible de

[1] Such marked autophony that the patient was unable to distinguish the notes of the piano.

distinguer les notes du piano." The description of these cases forces the inference that Sexton's interpretation of the term "autophony" is entirely at variance with that universally accepted, *i. e.*, hearing one's own voice through the Eustachian tube.

10. ROHRER publishes a case of complete bilateral deafness occurring suddenly, in a girl aged twelve years, eight days after an attack of measles. In connection with this mental depression, sluggish action of the pupils and occasional tinnitus aurium were also present. Physical examination revealed a normal state of the ear and intumescence of the nasal and pharyngeal mucous membranes. Inflation of the middle ear produced no palpable difference. Later on, epileptoid spasms followed attacks of violent headache, and disorders of speech and vision also supervened. Three weeks after the onset of the deafness, former hearing power was suddenly restored. Rohrer inclines to the belief that the co-existing naso-pharyngeal catarrh may have induced the preliminary impairment in hearing. Complete deafness, in connection with profound nervous disturbances in general, and the involvement of the acoustic nerve, would indicate central changes.

11. ZAUFAL was able to make a thorough naso-pharyngeal examination five minutes after painting the lower surface of the soft palate, the posterior wall of the pharynx, and the base of the tongue, with a five-per-cent solution of cocaine. Similar attempts in the case of a boy, aged twelve, after an application of a ten-per-cent. solution, were futile. Three minutes after application of a five-per-cent. solution to the nasal septum and lower turbinated bone, the touches of a probe produced no irritation, and the pricking of a paracentesis needle was not noticed. Three drops of a two-per-cent. solution were instilled into the auditory meatus, and twenty-seven minutes later the membrane was rendered so anæsthetic as not to feel the touch of a probe ; the only indication was the subjective noises caused thereby. In another case, four drops of the same solution produced complete loss of sensibility of the membrane, and lower wall of the osseous meatus in twenty-one minutes. Four drops of the same solution were instilled into the right ear of a female patient suffering from subjective tinnitus due to anæmia. Five minutes later the woman experienced a ringing noise, alternately, in both ears. After a lapse of twenty minutes the anterior segment of the membrane was rendered so anæsthetic, that the noises consequent upon the touch of the probe, were experienced more distinctly than the touch itself. After

thirty-five minutes this part of the membrane was completely anæsthetic to touch, nothing but the noises being perceived. During this entire period the posterior half of the membrane was uniformly sensitive to the touch. These favorable results are, however, qualified by equally numerous negative attempts. In the case of a man, aged fifty-four, an application of a ten-per-cent. solution for twenty-two minutes, did not produce the slightest change in the sensibility of the membrane and the auditory meatus. Zaufal also noticed that probing did not produce any hyperæmia after the use of cocaine. In fact, previous congestion seemed to disappear after its use. A few drops of a two-per-cent. solution were instilled through a perforation of the membrane into the middle ear, and after twenty-five minutes the parts were so benumbed that the touch of the probe on the promontory was not felt. In the case of a boy, aged ten, the use of a five-per-eent. solution reduced the sensibility sufficiently to permit the snaring and removal of a granulation from the tympanic cavity, without any resistance or calling forth pain. In another case, in which the removal of a granulation was exceedingly painful, the remainder of the operation was painlessly performed, after instilling a few drops of a five-per-cent. solution into the ear.

12. MOURE and BARATOUX have derived benefit from the use of cocaine in acute inflammatory affections of the ear. They have also used it in coryza, and with marked benefit in two cases of otorrhœa which had resisted the usual mode of treatment. After application of a ten-per-cent. solution, both nasal and aural polyps were painlessly removed. Galvano-caustic operations on the tonsils and in the nose were rendered painless, after a previous use of three-per-cent. or five-per-cent. solutions of cocaine.

13. In addition to a general review of the whole subject, with abstracts of the already published cases, C. relates one case. The patient was a girl who, a month preceding the examination, had had mumps. As the attack was subsiding she was suddenly seized with dizziness, staggering, nausea, and vomiting. Seen four days afterward, she was in bed on account of the nausea and giddiness. Temperature and pulse normal; tongue coated. After the action of some calomel powders the nausea and dizziness disappeared, but a deafness in the right ear remained. When tested by C., there was no perception of sound by the watch, tuning-fork, or Politzer's acoumeter. Inflation made no change. *Mt* indicated a past inflammation of the middle ear. Hearing in

L, $\frac{36}{12}$; condition of *Mt* same as R. Pharyngitis. Examined four and a half months after, the hearing in L was $\frac{40}{12}$; increased by inflation to $\frac{48}{12}$. R still in same condition as regards watch, but the tuning-fork is heard on bone and also at a distance of four inches from the ear; the acoumeter, at two inches. The author thinks it probable that the disease extended from the parotid gland through the middle ear to the labyrinth.

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14. H. believes that the impaired hearing which is improved by noise is due to (1) a relaxed condition of the *Mt*, or (2) a destruction of the proper relation between it and the stapes. A loud noise, he thinks, overcomes these conditions.

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15. Description and figures of the various instruments. The case is manufactured by Caswell, Hazard, & Co., N. Y.

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16. The cases, eight in number, are from Dr. Sexton's aural service at the N. Y. Eye and Ear Infirmary. In all, diseased teeth were found, and "very soon after, a cure was effected by the extraction of the diseased teeth."

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EXTERNAL EAR.

17. Dr. BARTSCH, of Parchim. A case of perichondritis auriculæ. *Monatschr. f. Ohrenheilk.*, No. 12, 1884.

18. Dr. LOUIS BLAU, of Berlin. Two rare diseases of the external ear. *Berliner klin. Wochenschr.*, No. 33, 1884.

19. Dr. MÉNIÈRE. Acute mastoid periostitis. *Revue mens. de laryng., d'otol.*, etc., 1884, p. 224.

20. Dr. NOQUET, of Lille. Foreign bodies in the ear. *Ibid.*, p. 220.

21. Dr. GELLÉ, of Paris. Circumscribed periostitis of the external meatus.

17. The case of perichondritis described by BARTSCH affected the posterior convex surface of the auricle. It was characterized by a soft, flattened swelling the size of a bean, the skin covering it being of a bluish-red discoloration. Several fistulous tracts were also present, and the cartilage was exposed and roughened. The patient was chloroformed, the fistulous tracts slit open, and all morbid tissue curetted with Wolff's sharp spoon; rapid recovery ensued.

18. BLAU describes a case of isolated spasm of the auricular muscles occurring in a boy aged ten years. Coëxisting there were occasional paroxysms of sudden pain in both ears, and hyperæsthesia of both auricles and external meatuses to the slightest touch. Treatment consisted in narcotic embrocations to the hyperæsthetic parts and plugging the ears with cotton. This was soon followed by complete cure. Blau attributes the spasm to an irritation of the auricular branches of the facial nerve, caused by reflex action of the sensory filaments of the trigeminus distributed in the external ear.

He further describes a case of diphtheria of the external meatus following measles. During the period of desquamation, the patient suddenly experienced severe pain in the left ear, impairment of hearing, and subjective tinnitus. Diphtheritic membranes began to form and soon covered the membrane and the walls of the meatus. No perforation of the membrane existed. A treatment with warm-water applications, syringing with solutions of boracic acid, and the use of the latter as a powder, was instituted. Eleven days after, tonsillar diphtheria developed, but recovery soon took place. Fully three weeks elapsed ere desquamation had ceased in the external meatus. This is the first instance of diphtheria of the external meatus following measles on record. Blau prefers his mode of treatment to that of Burckhardt-Merian, which consists of cauterization and the forcible removal of the membranes.

19. MÉNIÈRE refers to a previous publication in 1879, and erroneously [1] claims priority of first calling attention to the complication of inflammation of the external meatus in mastoid periostitis. He advocates a free incision down to the periosteum of the mastoid process.

20. NOQUET describes the removal of a foreign body from the ear by repeated syringing.

21. GELLÉ, basing his observations on five cases, describes an affection involving the external meatus, which he entitles "otite externe périostique circonscrite." This affection, which must not be confounded with furuncles of the external meatus, always ends in resolution under the action of emollients. According to his description, it is rheumatic in nature, generally affects both ears simultaneously, and is usually accompanied by a rheumatic inflammation of the fauces.

[1] *Vide* Hagen: "Die circumscripte Entzündung des äusseren Gehörganges," Leipzig, Veit and Comp., 1867, pag. 22.

THE MIDDLE EAR.

22. C. MIOT. The action of the neutral sulphate of atropine upon the course of acute inflammations of the ear in children. *Revue mens. de laryng., d'otol.*, etc., No. 8, 1884.

23. SAMUEL SEXTON. On the treatment of a case of acute catarrhal inflammation of the middle ear by removal of accumulated secretions from the tympanum through the Eustachian tube. *The Lancet*, Oct., 18, 1884.

24. W. MEYER. The nature of chronic suppurations of the tympanic cavity. *Archiv f. Ohrenheilk.*, Bd. xxi., page 149.

25. Dr. A. EITELBERG, of Vienna. The treatment of otorrhœa with solutions of corrosive sublimate. *Wiener med. Presse*, 1884.

26. Dr. RAFAEL ARIZA. Suppurative inflammation of the middle ear and its treatment. Madrid, 1884.

27. JOH. NATHAN. The presence of the bacilli of tuberculosis in otorrhœa. Inaug.-Dissert.

28. ARTHUR NEVE. Disease of the mastoid cells, operation by incision and gouging, recovery, remarks. *The Lancet*, Sept. 20, 1884.

29. Prof. ZAUFAL. Thrombosis of a sinus following otitis med. supp. *Prager med. Wochenschr.*, No. 48, 1884.

30. Dr. DELSTANCHE, of Brussels. The treatment of atrophic catarrh of the middle ear (sclerosis). *Annales des mal. de l'oreille*, etc., 1884, page 335.

31. DÉJERINE. Compression of the chorda tympani. *Progrès médical*, No. 33, 1884.

32. Dr. JOH. HABERMANN, of Prague. Tenotomy of the stapedius. *Prager med. Wochenschr.*, No. 44, 1884.

33. Dr. REEVE. Brief remarks upon fifty cases of trephining *Tro*f the mastoid. *ans. Med. Assoc. of Canada*, 1884.

34. W. A. BARTLETT. Neglected otitis media purulenta following vaccination and complicated with caries and necrosis of the mastoid; illustrating the favorable termination of the diseases without active interference. *N. Y. Med. Journ.*, Sept. 13, 1884.

36. C. J. LUNDY. The dry treatment of chronic suppurative inflammation of the middle ear. *Med. News*, July 5, 1884.

36. C. S. TURNBULL. Does a chronic discharge from the ears make life insurance hazardous? *Trans. Med. Soc. of Pa.*, 1884

22. MIOT has used solutions of atropine in his clinic in the treatment of children suffering from acute coryza with ear complications. He found its action extremely efficient in controlling the inflammation in the nose and preventing its extension to the ear. To exemplify, he selects out of thirty observations the case of a four-year-old girl who had suffered repeatedly from attacks of acute nasal catarrh with accompanying pain in the ears. The immediate use of two to four coffee-spoonfuls daily of a solution of atropine (gr. $\frac{1}{60}$ ad $\frac{z}{3}$ iiss.) prevented aural complications in subsequent attacks of coryza.

23. SEXTON describes a case of acute inflammation of the middle ear, occurring in the person of Prof. Bryant, with marked deafness, vertigo, nausea, tinnitus, and autophony. Examination revealed a marked bulging of Shrapnell's membrane, due to a collection of secretion in the upper part of the drum cavity. Sexton, after introducing a flexible catheter into the Eustachian tube, removed the fluid by the suction of a syringe. Immediate improvement followed.

24. According to MEYER, the granulations so frequently seen covering the labyrinthian wall of the middle ear in cases of chronic purulent catarrh, always cover exposed bone. Even on disappearance of these granulations, the exposed bone may be suspected by the presence of a small scab and can be detected by the touch of the probe. If complete restoration of the soft parts has taken place, the exposed osseous portion gradually merges into the surrounding structures. Instead of an epithelial, it is then covered by an epidermal, layer.

The connection of these areas of exposed bone and the diseased state of the tympanic mucous membrane is explained by the fact that the labyrinthian wall, having no vessels itself, depends upon the overlying mucous membrane for its nutrition. A submucous infiltration will cut off the supply of nutrition from this source, and the vessels of the osseous structure being insufficient, a superficial necrosis of the underlying bone ensues. This sequestrum acts as a foreign body, as evidenced by the sprouting granulations. The area of necrosis is indicated by a small red spot, through which the pus exudes. Palpation with a probe will reveal the roughened and exposed bone. The position and relation of the parts do not favor a spontaneous elimination of the necrotic elements, and the acute process develops into a chronic state.

The long continuance of the disease is caused by the necrosis,

a continual discharge and the constant development of granulations being kept up. The discharge becoming disorganized, furthermore exerts a deleterious action on the remaining mucous membrane of the tympanum. The author considers the vast majority of these osseous complications due more to a necrotic than a carious process. If such were not the case, the labyrinth itself would necessarily become involved much more frequently. Other parts of the bony tympanum are not so prone to disturbances of nutrition ; probably owing to the fact that their mucous membrane is less firmly adherent to the subjacent bone, and that an anastomotic circulation is more easily established. Caries is more apt to occur here than the above-mentioned process, and may also prove the active cause of a chronic suppuration. The author attributes the destruction of the soft structures and the underlying bone to the virulent action of the secreted pus. The floor of the tympanum rarely participates in this process ; probably due to an inherent resistance of this part of the bone to the destructive action of the pus. The lower anterior portion of the labyrinthian wall, on the contrary, frequently reveals bow-shaped areas of exposed bone, and it is quite probable that the constant irritating action of the decomposed pus will exert a destructive influence upon the soft structures. These soon become disintegrated, and the bone is secondarily affected. These facts point to the necessity of a careful treatment of all acute inflammations of the tympanum, of an early paracentesis to prevent the pressure of the accumulated secretion upon the tympanic mucous membrane. The early evacuation of the pent-up pus will also obviate the irritating action of the products of decomposition, which may develop at any period as long as the tubes are patent.

25. EITELBERG has tested the efficacy of 0.1–0.2-per-cent. solutions of corrosive sublimate in the treatment of purulent middle-ear catarrh. Its use was beneficial in cases of diffuse external otitis subsequent upon purulent inflammation of the middle ear. It further appeared to assuage the pain in acute inflammation, and occasionally to exert a controlling effect on the otorrhœæ. In efficacy it ranks below boracic acid, nitrate of silver, and even iodoform. Eitelberg derived no appreciable benefit from the dry treatment in combination with plugs of iodoform gauze.

26. ARIZA treats exhaustively (54 pages) and most thoroughly of the symptoms, complications, and treatment of purulent affections of the middle ear.

27. NATHAN examined the pus of forty cases of otorrhœa placed at his disposal by Prof. Bezold. In twelve of these he found bacilli of tuberculosis. Amongst forty-six preparations these were demonstrable in forty. Other traces of pulmonary tuberculosis corroborated these results in eight of the twelve cases. Physical examination revealed no pulmonary affection in the ninth case, that of a scrofulous child. The remaining three were subjects to caries; one suffered from a sequestrum in the mastoid, and caries of the ossicles existed in the other two cases. The other twenty cases, in which an examination revealed no bacilli, embraced various diseases; in three there was disease of the adjacent cells, and perforation of Shrapnell's membrane. The presence of bacilli in the aural discharge of those patients also presenting pronounced pulmonary complications, places beyond doubt the phthisical nature of the middle-ear trouble. It further exerts a determining influence upon the prognosis of these cases.

28. NEVE publishes a case of acute inflammation of the middle-ear, extending to the mastoid process, occurring in a syphilitic patient. The case was observed in the Cashmere Mission Hospital. Paracentesis of the membrane proving ineffectual, the mastoid process was opened and rapid recovery ensued.

29. ZAUFAL opened the mastoid process in a young man aged twenty-four, suffering from thrombosis of a sinus, the result of a purulent middle-ear inflammation. After penetrating to a considerable depth, he came upon an accumulation of pus, and found partial destruction of the floor of the sulcus sigmoideus and of the wall of the sinus. The sinus was syringed with a two-per-cent. solution of carbolic acid. Fourteen days later the patient succumbed to an attack of pleuro-pneumonia. There were no traces of a purulent meningitis. An organized thrombus at the jugular foramen resisted the advance of the stream of water in syringing. In answer to the question, whether or not, under these circumstances, trepanation of the mastoid is justifiable, Zaufal is of the opinion, "that other cases should be treated similarly, to increase the number of instances on record, so as to decide relatively the chances of recovery by spontaneous cure or by surgical interference."

31. DÉJERINE communicated to the Société de Biologie a case of pressure of the chorda tympani with subsequent atrophy, due to an intra-tympanic collection of secretion. The patient, however, presented no disturbances of the sense of taste during the

course of the illness, and all the muscles innervated by the facial nerve retained their Faradic contractility.

32. HABERMANN has added another case of tenotomy of the stapedius to the instances previously recorded by Kessel and Urbantschitsch. The latter has performed this operation three times. The case described is that of a woman who suffered from low noises in the right ear simultaneously with spasms of the right eyelid. Even after the latter had disappeared, the mere closing of the eyelids was sufficient to provoke an attack of the tinnitus; vertigo and a gradual impairment of hearing accompanied the above symptom. The whispering voice was heard merely at the distance of one metre, while the ticking of a watch was only detected on contact. The author attributed the tinnitus to a clonic spasm of the stapedius muscle occurring simultaneously with a spasm of the orbicular muscle, both being innervated by the facial nerve. After ineffectual treatment by electricity, he decided to perform tenotomy of the stapedius. The absence of the posterior half of the membrane, and the distinct definition of the descending process of the incus, the posterior ramus of the stapes, and part of the tendon of the muscle itself, greatly facilitated the operation. The muscle was divided with a paracentesis needle without producing any pain. The patient at the time merely experienced a slight movement in the ear accompanied by a faint tinkling sound. The operation was immediately followed, even on firm closure of the lids, by a complete disappearance of the tinnitus and the vertigo. The watch was now heard at a distance of 0.02 metre, while there was no palpable variation in distance for whispering voice. Habermann does not refer to the two cases described by Moos in this journal, in which the latter attributes the symptoms induced by spasm of the stapedius to negative variations of intra-labyrinthian pressure.

33. The statistics are incomplete; but, so far as known, in the fifty cases there were only eight deaths. In one case the middle cerebral fossa was entered, causing death. In another the lateral sinus was opened, but the patient recovered.

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34. Though the treatment (by Dr. Sexton) is claimed to be "non-active," the course pursued was such as is usually followed —namely, removal of polypi and granulation and the keeping up of effective drainage. When the sequestrum became loose it was removed by the forceps. SWAN M. BURNETT.

35. While recommending the method strongly where it is properly indicated, the author thinks it not useful in (1) very profuse discharges, (2) where polypi or granulations exist, (3) where there is caries or necrosis, (4) in mastoid. disease, or (5) in suspected meningeal complications. He likes the combination of boracic acid and resorcin. SWAN M. BURNETT.

36. The author answers this question in the affirmative. When an expert is not at command for complete examination of the organ of hearing, he suggests that the insurance examiner (1) cover the eyes and test each ear separately with the watch; (2) inspect in good daylight the entire auricular region, especially noting the condition of the mastoid or cicatrices thereabouts; (3) inspect (as gas-fitters do in proving their work) each auditory meatus. SWAN M. BURNETT.

NERVOUS APPARATUS.

37. LORENZ ECKERT. Ménière's disease. Verlag von Beno Schwabe, Basel, 1884.

38. P. HERMET. Deafness in syphilitic tabes. *Union méd.*, No. 86, 1884.

39. VERMYNE. Myxo-fibroma at the basis cranii causing blindness, and seven years after, complete deafness, by destruction of the labyrinth. *Phila. Med. News*, July 26, 1884.

40. C. A. TODD. Necrosis of the right labyrinth; total facial paralysis on the same side; partial recovery. *Trans. Amer. Otol. Soc.*, 1884.

41. C. H. BURNETT. Reflex aural phenomena from naso-pharyngeal catarrh; objective noises in and from the ear. *Trans. Amer. Otol. Soc.*, 1884.

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37. In this treatise ECKERT reviews in a comprehensive manner all hitherto published cases and articles pertaining to Ménière's disease. Based upon these and fifteen cases of Burckhardt-Merian, as yet unpublished, the author attempts to draw a distinct anatomical basis for the various symptoms of Ménière's disease, and arrives at the following conclusions:

1. The semicircular canals, with their ampullæ, are the organs of the sense of co-ordinate motion, directly for the head, indirectly for the entire body.

2. The localization of sound is determined by binaural power

of hearing. The semicircular canals take no part in this, but possibly exert acoustic functions in other respects.

3. The appearance of the various symptoms of Ménière's disease is in most cases attributable to a diseased state of the terminal apparatus of the acoustic nerve in the labyrinth. It is only in rare instances that these are called forth by pathological changes in the adjoining nerve centres.

4. Pathological changes or conditions in the middle ear and in surrounding structures, producing a change in the intra-labyrinthian pressure, may call forth a similar train of symptoms.

5. The symptoms are induced by an irritation of the labyrinthian organs or their nervous centres. Complete destruction of the same seldom calls forth a loss of function.

6. Disturbances of co-ordinate motion may be absent in pronounced chronic or acute affections of the labyrinth.

7. Constitutional diseases, such as lues, leukæmia, epidemic parotitis, and tabes, are recognized factors predisposing to the development of Ménière's disease.

A careful recapitulation of the literature on this subject closes the article.

38. HERMET reports several cases of almost sudden deafness affecting patients suffering from syphilitic locomotor ataxia. Deafness generally develops in the pre-ataxic stage ; occasionally it sets in when the disease is quite pronounced. This form of deafness is characterized by its rapid development and by the unaffected state of the middle ear. This condition is probably analogous to atrophy of the optic nerve in the same affection. If it develops at an early stage, other symptoms of tabes should be sought for. Similar aural troubles, due to inherited syphilis, develop between the age of fifteen and twenty.

39. VERMYNE reports the history of a patient who, in 1876, complained of slight visual impairment. Excepting a hyperæmic state of the papilla and the retina, nothing abnormal was found. Three months later, attacks of violent headache and neuritis optica led to the diagnosis of cerebral tumor. On examining the case five years later, Vermyne found atrophy of the optic nerve and complete loss of vision. Total deafness soon developed, and the patient died eight years after the onset of the disease. An autopsy revealed a tumor 6 *cm.* long, 4 *cm.* broad, and 2 *cm.* in thickness, occupying the inferior occipital fossa. The left cerebellar hemisphere was compressed to one third its normal size.

Both cerebrum and cerebellum were anæmic and the ventricles distended with fluid. That part of the tumor of most recent development encroached upon the petrous portion of the temporal bone, completely destroying the portion between the posterior part and the exposed tympanic cavity. The membrana tympani was intact. A microscopic examination showed the tumor to be myxo-fibromatous in character.

40. A discharge following measles since her fourth year. Left ear healed; right continued to discharge. When nineteen, granulations and a sequestrum of bone removed, which was found to be the cochlea. Paralysis of that side of the face, and loss of taste in the part supplied by chorda tympani nerve. Under electricity the facial muscles regained some of their power. SWAN M. BURNETT.

41. The author thinks that objective noises in the ear may be due in some instances to reflex influences from the inflamed nose-pharynx. The irritation is, in this case, reflected to the muscular tissues of the velum palati, the fibres of the superior constrictor of the pharynx and the pterygoid muscles producing clonic spasms, which cause the snapping noises heard sometimes at quite a distance from the patient. Several cases are given in illustration. SWAN M. BURNETT.

NOSE AND NASO-PHARYNX.

42. Dr. TH. HERING, of Warsaw. The use of chromic acid as a caustic in diseases of the nose, pharynx, and larynx. *Bulletin et mém. de la Sociéte franç. d'Otol.*, tom. i., p. 149.

43. Dr. RAFAEL ARIZA. The influence of chronic coryza and follicular pharyngitis on the singing voice. Madrid, 1884.

44. Dr. VOLTOLINI, of Breslau. Epistaxis. *Revue mens. de laryngol. d'otol.*, etc., No. 11., 1884.

45. Dr. CZARDA. Foreign bodies and calcareous concretions in the nose. *Gaz. médic. de Paris*, No. 49, 1884.

46. Dr. SCHMIEGELOW. Remarks on rhinoliths. *Revue mens. de laryng. d'otol.*, etc., No. 11, 1884.

47. Dr. H. SCHMALTZ. Indications for the operative removal of Luschka's gland. Jahresbericht der Gesellschaft für Natur und Heilkunde in Dresden, 1884.

48. B. FRÄNKEL. Adenoid vegetations. *Deutsche med. Wochenschr.*, No. 41, ff., 1884.

49. Dr. GUYE. Mouth-breathing from a hygienic standpoint. Congrès intern. d'hygiène, etc. Amsterdam, 1884.

50. J. A. WHITE. Naso-pharyngeal obstructions and hypertrophies in their relation to hearing. *Trans. Va. Med. Soc.*, 1884.

42. According to HERING, the apparent inconvenience attending its use, and the fear of toxic effects, have been the only drawbacks to a more extended use of chromic acid. As employed by the author however, its use is extremely convenient; he simply fuses a crystal upon the end of a heated silver probe and applies it as the case may require. The trifling pain attending its use is a point in its favor. Unpleasant after-results are prevented by cleansing the nares with a solution of soda. Hering has used it with best results in the treatment of adenoid vegetations, granulations, polypi, hypertrophies, etc. His experience leads him to consider it the most efficient medicinal agent at hand in the treatment of chronic nasal catarrh with thickening and hypertrophy of the turbinated bones.

43. ARIZA draws attention to the unfavorable influences which chronic nasal catarrh and follicular pharyngitis exert upon the singing voice. These conditions frequently lead to follicular laryngitis and reflex paralysis of the laryngeal muscles. Instructors should bestow greater attention to these troubles and induce pupils to adopt curative measures.

44. Following some anatomical introductory remarks, VOLTOLINI refers to a case of epistaxis, described in his treatise on "Rhinoscopy and Pharyngoscopy," in which the source of the hemorrhage was traced to a small excrescence situated between the middle and lower turbinated bones. Since then, he is also able to confirm the observations of others, that cases of habitual epistaxis generally originate from a small area of the cartilaginous septum. The author attributed one case of epistaxis, in which he could not trace the source, to diapedesis. The application of the galvano-cautery to the inferior turbinated bone soon checked the hemorrhage. Voltolini attributes habitual epistaxis to a personal predisposition and to the vascular state of the nares. The author treats all cases with the galvano-cautery. The patient should stay in-doors till all inflammation subsequent upon the application has subsided. Voltolini recommends anterior and posterior tamponing of the nose in violent hemorrhages. In tamponing the naso-pharynx, the soft palate is drawn forward by the hook, and the cotton tampons are introduced with forceps having a retro-nasal

curve. In addition, the author extols his method of examination by direct sunlight, the use of his nasal speculum, his galvano-cautery, etc. The publications of Kisselbach and of the reviewer pertaining to this subject seem to have escaped his attention.

45. CZARDA reports five cases of foreign bodies in the nose. In the first case the nucleus consisted of a plug of cotton and a piece of cork weighing 7 grm.; the second instance was a mass of lime concretions surrounding the half of a plum-stone; the third, a pea swollen to triple its natural dimensions; and the fourth, a cork the size of a bean. The fifth case occurred in a man, aged thirty-two, who suffered nightly of violent itching in the nose, and who presented all symptoms of neurasthenia. Examination revealed the presence of a juniper berry which, after removal, weighed 25 grm. The size of the concretions on it points to the probability that its presence dated from early youth. Unilateral coryza was a constant feature in all the cases, and, according to the author, is characteristic of the presence of rhinoliths or other foreign bodies.

46. SCHMIEGELOW reports the case of a patient who had been subject for sixteen years to a purulent, fetid discharge from the left nostril, and who also suffered from total impermeability of the same side. On becoming flushed, a profuse unilateral sweating always affected the same side of the head. This symptom disappeared four years prior to the period of examination. Inspection revealed the presence of a rhinolith, which, after being crushed with a pair of strong forceps, was removed by syringing. The concretion contained no nucleus, was laminated in structure, and enclosed but little organic matter. Schmiegelow considers a fetid, purulent discharge existing for years, in combination with total occlusion of the nostril, always significant of the presence of rhinoliths.

47. SCHMALTZ dwells upon the frequency of hypertrophy of Luschka's gland. In diagnosis, he avails himself of posterior rhinoscopy without the use of the palate-hook. He operates with Hartmann's wire snare, modified by him to be used with the galvano-cautery. The more pronounced the symptoms, especially impediment to free nasal respiration, the earlier he operates. Aural complications favor early interference of the disease. The operation itself is rarely followed by any inflammatory reaction, and relapses never occur. The removal of only small portions is in itself sufficient to produce surprisingly favorable results.

48. B. FRÄNKEL treats of adenoid vegetations in the naso-

pharynx in a "text-book" style, similar to the publications of Meyer, Löwenberg, and others. The nature, origin, appearances, examinations, symptoms, and treatment of this disease are dwelt upon in a most thorough and exhaustive manner.

49. Referring to the well-known expression of Catlin, "Shut your mouth and save your life," GUYE expatiates upon the causes and vicious results attending mouth-breathing. He treats this faulty habit by the use of a contra-respirator. This respirator, which he described ten years ago, differs from others of the same class in having an impermeable plate, and compelling the wearer to breathe through the nostrils.

50. W. considers the dust from macadamized streets a prolific cause of naso-pharyngeal irritation. His experience substantiates the belief that vegetations in the upper pharnyx frequently cause deafness. In all cases of mouth-breathing, and in all cases of obstruction in the lower nasal meatus, there will ultimately be impaired hearing. The author then goes on to consider the various forms of nasal and pharyngeal obstruction. He considers chromic acid one of the best chemical cauteries. When the hypertrophy of the tonsils is dense, he extirpates. SWAN M. BURNETT.

MISCELLANEOUS NOTES.

Baron LÉON DE LENVAL, at Nice, France, has founded a *prize of frs. 3,000, as a premium for the best hearing trumpet constructed after the principle of the microphone.* Instruments competing for the prize are to be sent before Dec. 31, 1887 to one of the members of the jury, Prof. E. Hazenbach-Bischoff, M.D., Basel ; Dr. Benni, Warschaw ; Prof. Burckhardt-Merian, Basel ; Dr. Gellé, Paris ; Prof. A. Politzer, Vienna.

In awarding the prize particular attention will be paid to the perfection of the mechanical construction of the instruments, the correct application of physical laws, and above all, its efficiency as an aid to persons hard of hearing. The decree of the jury will be published at the Fourth International Otological Congress at Brussels, Sept., 1888.

We welcome a new edition—the third—of W. B. DALBY's very excellent **Lectures on Diseases and Injuries of the Ear,** 260 pp. Churchill, 1885.

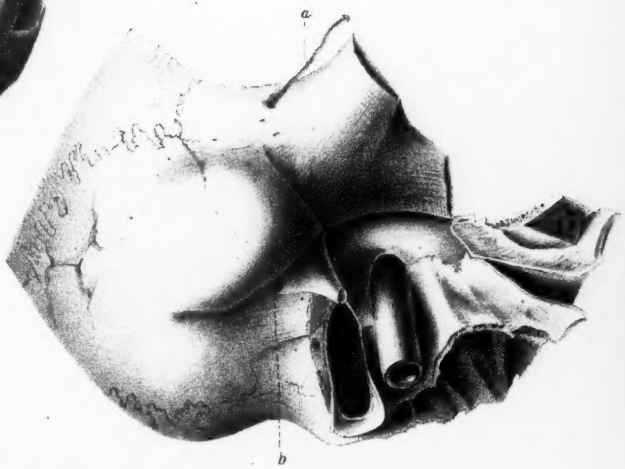
The chief new matter in this edition relates to tests of hearing, the position now occupied by operations on the tympanic membrane and one new lecture on adenoid growths and enlarged tonsils.

Fig. I.

Fig. IV a.

Fig. IV b.

Fig. II.



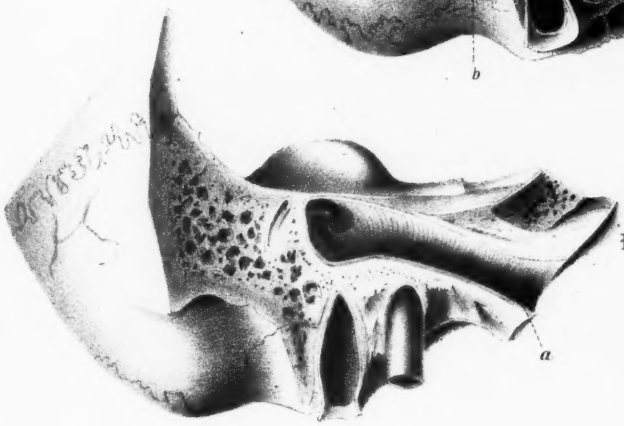


Fig. III.

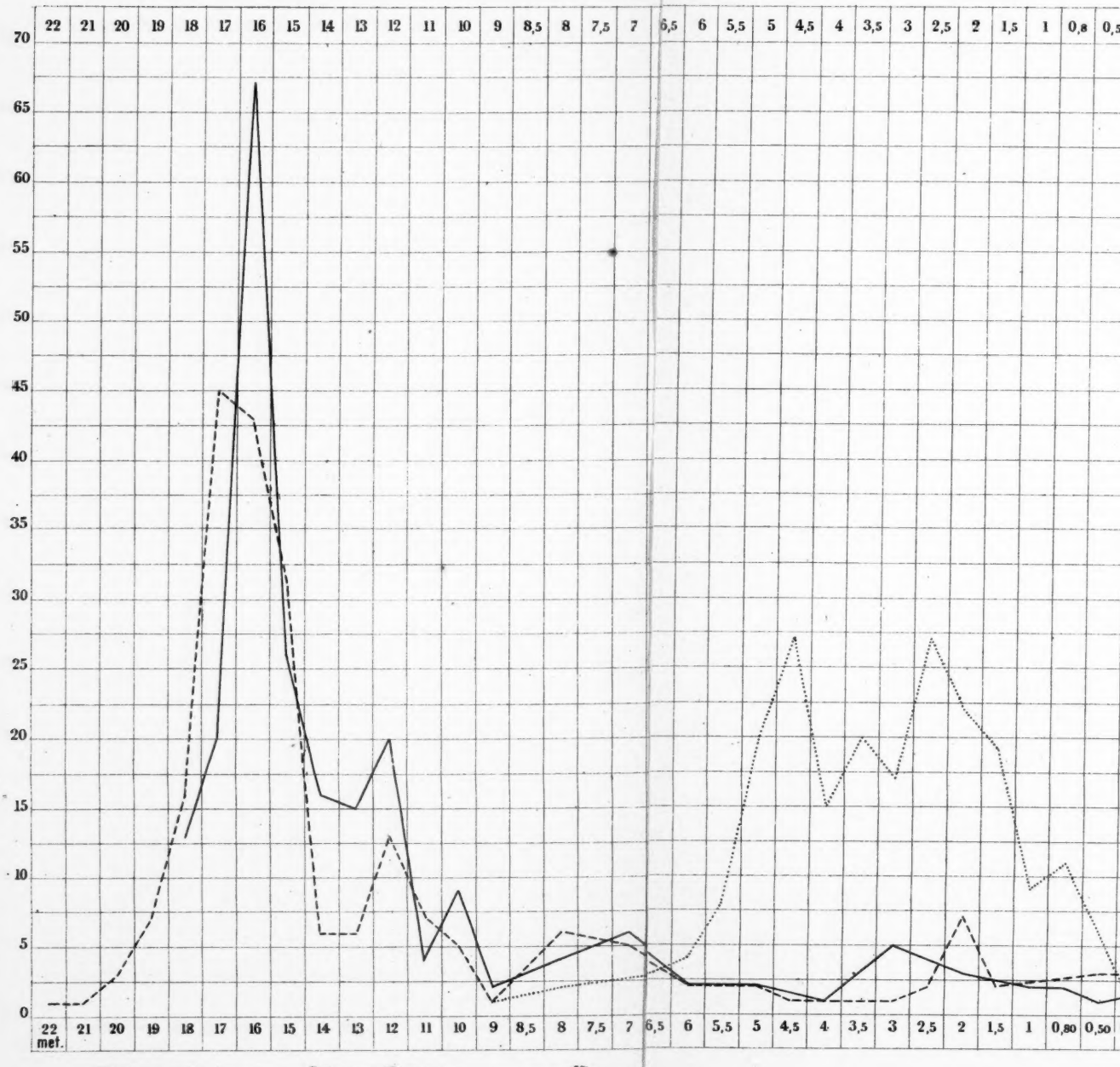
Rabus del.

Lith. Anst. v. C. Hirst, Leipzig.

Tab. I.

Holland'sches Jnstitut

Hörweite der 222 Gehörorgane für Flüstersprache,
Politzers Hörmesser und Uhr. (Tabelle I.)

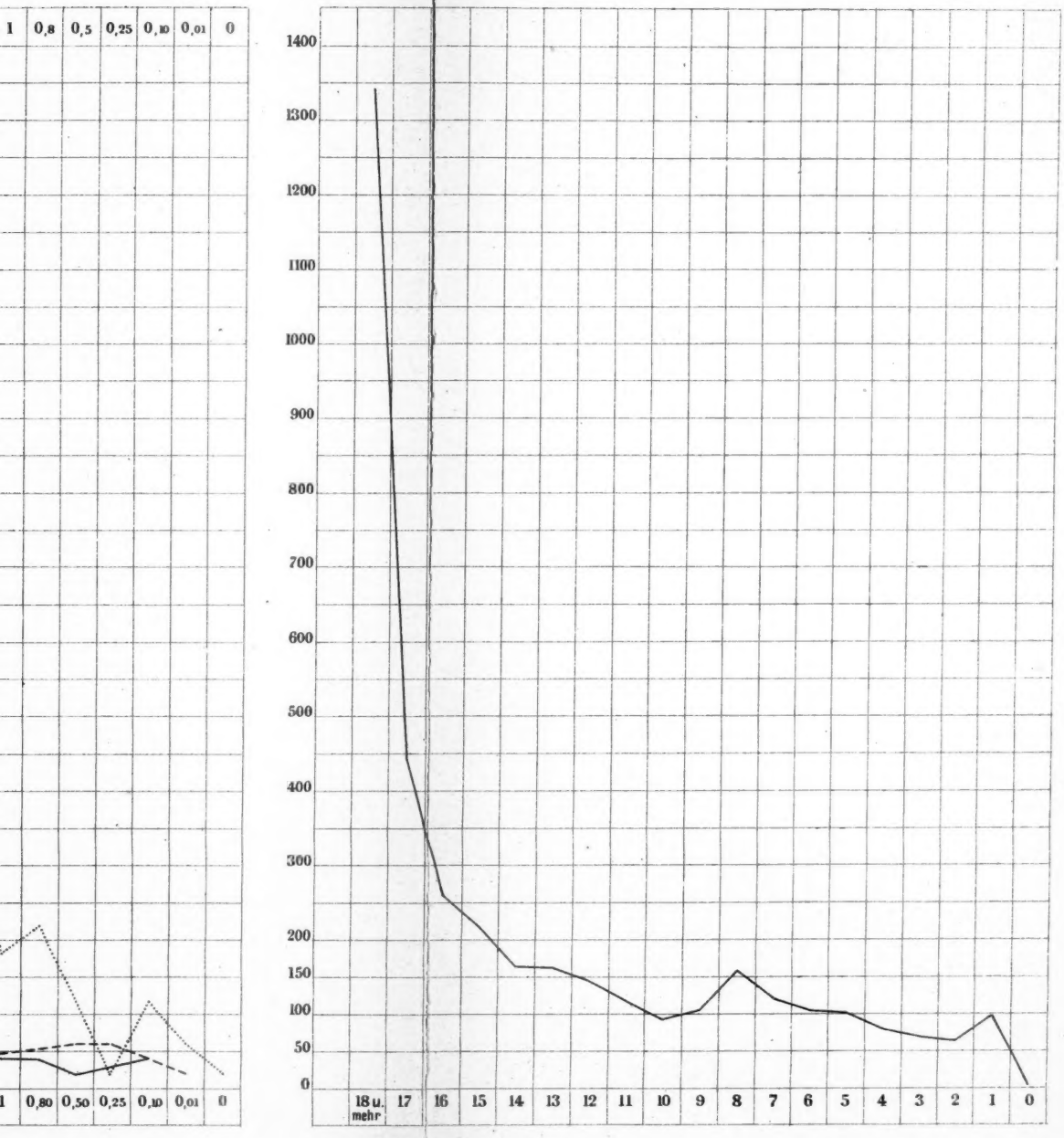


——— *Flüstersprache*. – – – – – *Politxers Hörmesser*. ..... *Uhr*.

Lith. Anst. v. F. Wirtz, Darmstadt.

Tab. II.

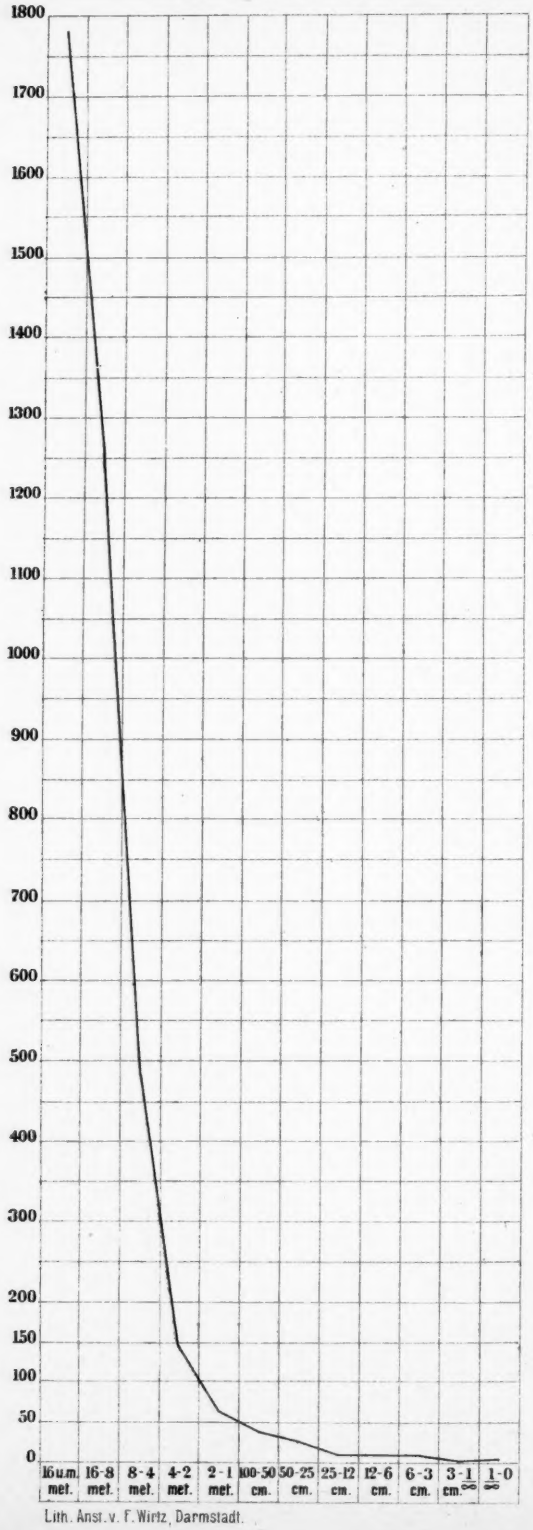
Hörweite der 3836 untersuchten Gehörorgane für Flüstersprache nach Metern eingetheilt. (Tabelle III.)



Verlag v. J. F. Bergmann, Wiesbaden.

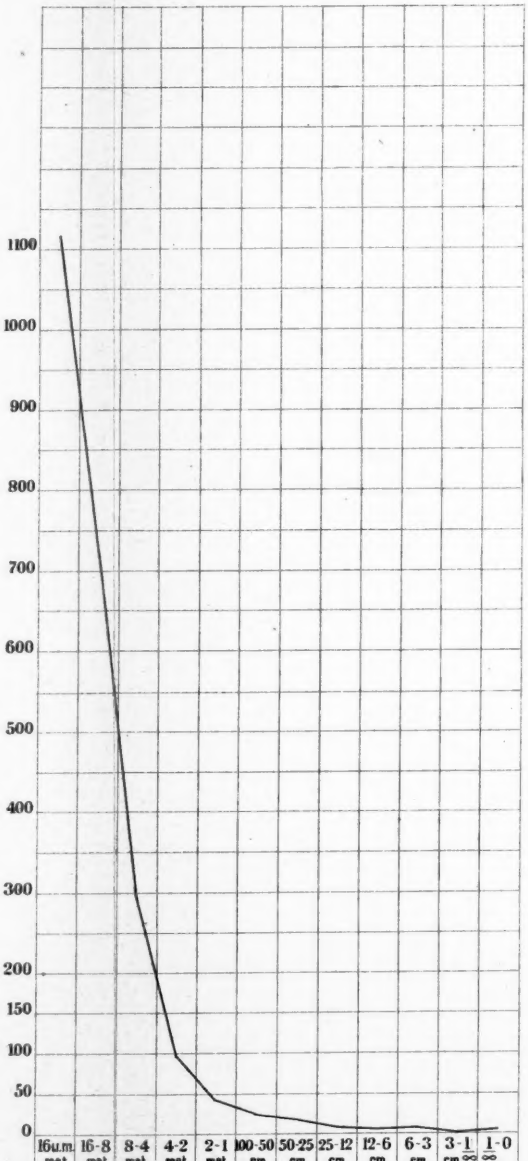
Tab. III.

Hörweite der 3836 untersuchten Gehörorgane für Flüstersprache nach annähernd gleichen Quoten. (Tabelle V.)



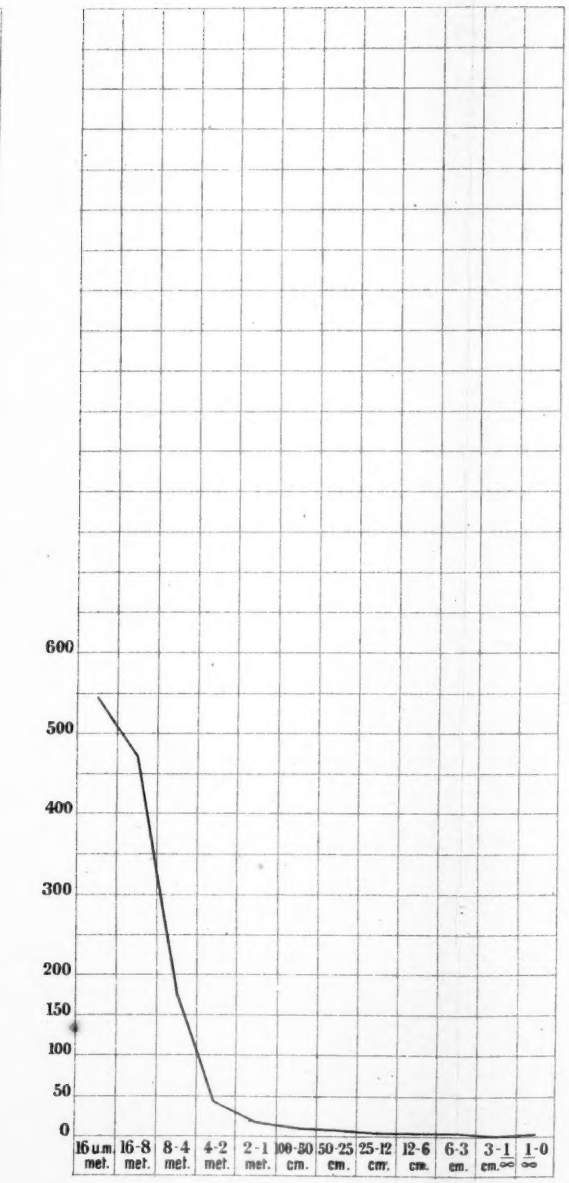
Lith. Anst. v. F. Wirtz, Darmstadt.

Simultanschule mit 2332 Gehörorganen. (Tabelle VII.)

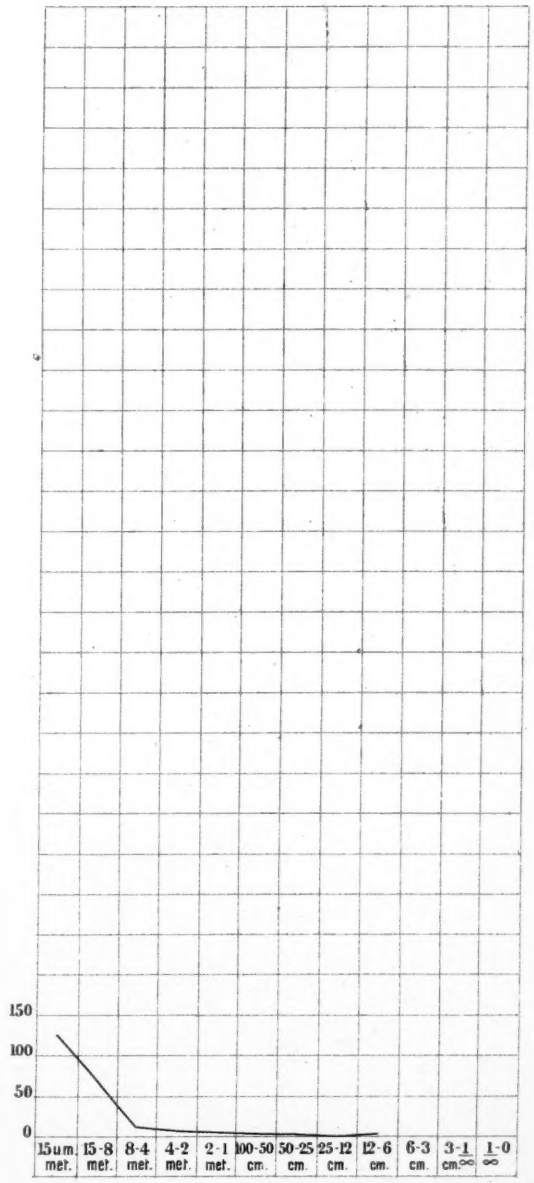


Tab. IV.

Protestantische Schule
mit 1282 Gehörorganen. (Tabelle VIII.)



Holland'sches Jnstitut
mit 222 Gehörorganen. (Tabelle VI.)



Verlag v. J. F. Bergmann, Wiesbaden.

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